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FISCAL YEAR 1992 DEPARTMENT OF ENERGY AUTHORIZATION

(Atomic Vapor Laser Isotope Separation R&D Program)

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY

OF THE

COMMITTEE ON
SCIENCE, SPACE, AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

ONE HUNDRED SECOND CONGRESS

FIRST SESSION

HEARING: APRIL 16, 1991

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1992 DEPARTMENT OF ENERGY AUTHORIZATION

WEDNESDAY, APRIL 10, 1991

House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Energy,
Washington, DC.

The subcommittee met, pursuant to notice, at 2 p.m., in room 2318, Rayburn House Office Building, Hon. Marilyn Lloyd (Chairman of the subcommittee) presiding.

OPENING STATEMENT OF HON. MARILYN LLOYD, CHAIRMAN, SUBCOMMITTEE ON ENERGY

Mrs. Lloyd. This is our final authorization hearing to review the Department of Energy's fiscal year 1992 budget request. Our subject today is the uranium enrichment enterprise and the R&D program, the Atomic Vapor Laser Isotope Separation or AVLIS project.

Two years ago, this Subcommittee held an authorization hearing on the AVLIS program, and during the testimony, witnesses heralded an agreement which would inject some business experience into this program in anticipation of deployment. Then, last year, DOE issued its deployment plan. We are in some ways further away from deployment now than we were when the plan was presented at the beginning of fiscal year 1989.

I am pleased by reports that the technology is progressing and is on schedule. However, on the deployment side, I am gravely concerned. We have invested a total of $1.1 billion into this R&D program to date and the department is requesting another $213 million. They are not, however, requesting any money for predeployment activities. If we are not going to deploy this technology, I am interested in the rationale for request for further investment.

Our witnesses today will give us information on the program and the progress of the program. We will examine predeployment activities—both those that are being performed and those that we feel should be underway.

Before we begin, it is always my pleasure to recognize our distinguished ranking member, the gentleman from Washington State, Mr. Morrison.

OPENING STATEMENT OF HON. SID MORRISION, RANKING REPUBLICAN, SUBCOMMITTEE ON ENERGY

Mr. MORRISON. Thank you, Madame Chairman. I am pleased that the Subcommittee has moved on ahead to aggressively be in a position to authorize. That is one of our goals.

AVLIS is an, I think, an exciting technology for those of us that have been watching at a safe distance all these years. I, too, and I sense in your voice because of your direct interest in it a high level of enthusiasm for getting on with it.

I would agree. I would hope that we could get to the point of applying this absolutely exciting concept. We have had the privilege of visiting it at one of our committee hearings in California. We now feel strongly about saying let's share this with the real world applications.

So I look forward to our witnesses today.

Thank you for holding the hearing.

Mrs. LLOYD. Thank you very much, Mr. Morrison.

I would announce at the beginning of the hearings, we do ask unanimous consent that today's proceedings be covered by the media and those that would like to record the hearing.

I would also like to tell all of the witnesses that we will be submitting questions in writing for you on this very important hearing that we would like you to respond to as quickly as possible, so that they can be included in the record of hearing.

In our first panel this afternoon, we welcome the Honorable William Young who is the Assistant Secretary for Nuclear Energy at the Department of Energy.

Sitting next to him is Mr. Robert Bernero of the Nuclear Regulatory Commission. Mr. Bernero is Director of the Office of Nuclear Material Safety and Safeguards.

Completing this panel, we welcome again Mr. Victor Rezendes who is Director of Energy Affairs at the General Accounting Office.

Gentlemen, we ask that you summarize your written testimony into about ten minutes of oral presentation. Of course, your complete statements will be included in the record. This will allow us time to ask our questions.

Before we begin, I would like to recognize Mr. Wolpe. Do you have any opening statements you would like?

Mr. WOLPE. Thank you, Madame Chairman. I don't really. I am looking forward to finding out what is happening with respect to policy at this point on this particular project. Thank you very much.

Mrs. LLOYD. Thank you very much.

Mr. MORRISON. Madame Chairman, I think the record should show that Bill Young had his choice of being in Japan addressing the atomic industrial forum or here with us. He chose to be with us.

Mrs. LLOYD. We do thank you, Mr. Young. We will try to be kind to you today. Please proceed, Bill.

[The prepared opening statement of Mr. Costello follows:]

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U.S. REPRESENTATIVE JERRY F. COSTELLO
SCIENCE, SPACE AND TECHNOLOGY COMMITTEE
SUBCOMMITTEE ON ENERGY
APRIL 10, 1991

Mr. Chairman, thank you for calling this hearing today to discuss the AVLIS program and Uranium Enrichment. I would like to welcome the witnesses to the Subcommittee on Energy as we discuss this important topic.

As our nation continues to find alternative sources of energy for use in the future, it is important to explore all options. Uranium Enrichment research and technology is critical to expanding our energy resources.

Again, Mr. Chairman, thank you for calling this hearing today. I look forward to hearing the testimony of our distinguished panel of witnesses.

STATEMENT OF HON. WILLIAM H. YOUNG, ASSISTANT SECRETARY FOR NUCLEAR ENERGY, U.S. DEPARTMENT OF ENERGY

Mr. YOUNG. Thank you, Madame Chairman. I will be brief.

I am pleased to have the opportunity to discuss our uranium enrichment program.

The Department's uranium enrichment enterprise is a vital part of the U.S. nuclear industry. As a business within the Government, the enterprise's mission is to produce and sell uranium enrichment services world-wide in a competitive manner.

In January of 1990, DOE transmitted to Congress a plan for the Demonstration, Transition and Deployment of Uranium AVLIS Technology. It showed completion of a demonstration of that technology in September of 1992. That plan also described predeployment activities which would lead to a determination of whether to proceed with investment in and deployment of, a production plant in November of 1992, based upon market conditions at that time.

The uranium AVLIS technology demonstration at Lawrence Livermore National Laboratory is proceeding on schedule. We are pleased with the technical progress being achieved. In Fiscal Year 1992, DOE plans to spend $213.6 million on demonstration activities, an increase of $71.8 million—or 50 percent—from the $141.8 million being spent during the current Fiscal Year. The purpose of this demonstration is to provide for full-scale testing of plant laser and separator systems, and to provide the operating, technical and economical data needed to support decisions on commercial plant deployment.

A number of major milestones have recently been achieved that are critical initial steps leading to full-scale technology demonstration testing.

In October 1990, the integration of laser light for the uranium AVLIS separator was achieved. This represented the initial introduction of light in the Uranium Demonstration System that will be used for full-scale demonstration tasks starting in December 1991.

In January of 1991, the first separator run in an off-line test facility, using a plant size separator pod was successfully completed. In that configuration, it will be used in the Fiscal Year 1992 demonstrations.

In February of 1991, a plant prototype of an advanced copper laser chain achieved a power level of 1500 watts for 24 hours. This represents 100 percent of the power level required in a uranium AVLIS production plant for copper lasers.

In March of 1991, copper laser and dye laser systems operated at power levels that are required for technology demonstration tests in 1992.

DOE plans to begin integrated testing of laser and separator systems in December of 1991, and the full series of planned tests should be completed on schedule in September 1992. This effort is expected to successfully produce the technical and economic information that is required to make future decisions on commercial plant construction and operation.

In addition to our efforts on the uranium AVLIS program, DOE has actively promoted legislation to transfer the Department's uranium enrichment business to a technical temporary Government

Enrichment Corporation that would manage, design, construct, and operate a future uranium AVLIS production plant. We had anticipated that Congress would enact legislation in 1990 to establish such a Government Corporation. Regrettably, the 101st Congress did not pass such legislation.

The Administration has determined, based upon policy considerations, that the Government should avoid investments in the uranium enrichment enterprise that could more appropriately be made by the private sector. In particular, the Administration expects the new Government corporation to make the decision on the deployment of uranium AVLIS. Thus, Government expenditures for uranium AVLIS predeployment activities have not been included in our Fiscal Year 1992 budget. Activities that will be discontinued in Fiscal Year 1992 include selection of a commercial deployment contractor, implementation of an industrial access program, execution of an NRC licensing process, evaluation of candidate plant sites, and preparation of environmental impact studies.

We have reviewed ongoing Fiscal Year 1991 pre-deployment activities in light of that Fiscal Year 1992 budget decision and have found that it is not practicable or prudent to select a commercial deployment contractor, initiate an industrial access program, or start licensing discussions, with the NRC if these activities will not be continued in Fiscal Year 1992. Licensing activities cannot be commenced in any event, since the NRC decided in January of 1991 that an applicant is required before the NRC will proceed.

We have concluded that the Department will proceed with the identification of candidate sites for our uranium AVLIS production plant and with the environmental studies for such sites, it can be completed in Fiscal Year 1991.

In this regard, the Department is announcing today that three proposed sites have been identified for location of a potential uranium AVLIS production plant. The proposed sites are located at DOE's existing Gaseous Diffusion Plants in Oak Ridge, Tennessee; Paducah, Kentucky; and Portsmouth, Ohio. These sites offer significant advantages in terms of capital and production costs and ease of plant implementation. They also possess an experienced labor force as well as strong capabilities in handling and storing uranium materials. We expected these sites, along with other reasonable alternatives, will be analyzed in a future Environmental Impact Statement prior to final selection of a site for a proposed uranium AVLIS production plant.

Though the administration believes that a temporary Government enrichment corporation is the most effective response to current market conditions, I want to assure the Committee that we are taking steps in the meantime to remain as competitive as possible. An example of that is that we are currently making incentive price offers necessary to capture new sales in the 1996 to 1998 time frame, based on market conditions. We think these offers are very competitive and will be a basis for continuing the revenues of the corporation to prepare it for a take-over by a Government corporation and ultimately the use of AVLIS for production.

Let me close by returning again to the urgency of passage of uranium enrichment restructuring legislation by the Congress as the most effective means to give the U.S. uranium enrichment enterprise the greatest future commercial flexibility and competitive edge.

This subcommittee under your leadership, Madame Chairman, reported uranium enrichment restructuring legislation last year. Chairman Sharp, for the Subcommittee on Energy and Power, agreed during last year's budget reconciliation process to make enrichment legislation a priority in the 102nd Congress. We are pleased to note that you have reintroduced the bill that you reported, and that Mr. McEwen has also introduced legislation. We note that Senators Ford and Johnston are continuing to spearhead efforts in the Senate. The Administration will be introducing its legislation shortly in time for the mark-up in the Senate on the Johnston-Wallop bill demonstrating our renewed commitment to legislation. We hope that hearings in both bodies will be scheduled at an early date.

We look forward to working closely with you and others to make such legislation a reality. The long-term success of the U.S. uranium enrichment enterprise depends upon such timely and long over due action.

I thank you for the opportunity to appear before this subcommittee. I would be happy to answer your questions later.

[The prepared statement of Mr. Young follows:]

STATEMENT OF WILLIAM H. YOUNG
ASSISTANT SECRETARY FOR NUCLEAR ENERGY
BEFORE THE
HOUSE SCIENCE, SPACE AND TECHNOLOGY COMMITTEE
SUBCOMMITTEE ON ENERGY

APRIL 10, 1991

STATEMENT OF WILLIAM H. YOUNG
ASSISTANT SECRETARY FOR NUCLEAR ENERGY
BEFORE THE
HOUSE SCIENCE, SPACE AND TECHNOLOGY COMMITTEE
SUBCOMMITTEE ON ENERGY

APRIL 10, 1991

Madam Chairman, I am pleased to have this opportunity to discuss the Department of Energy's (DOE) uranium enrichment program.

The Department of Energy's uranium enrichment enterprise is a vital part of the U.S. nuclear industry. As a business within the U.S. Government, the enterprise's mission is to produce and sell uranium enrichment services worldwide. To this end, DOE operates two facilities which enrich uranium for commercial and naval reactors. However, the existing uranium enrichment enterprise needs to be placed on a more competitive footing.

Commercial sales will generate approximately 90 percent of the enterprise's estimated $1.547 billion in gross revenues for FY 1992. Net revenue projected for FY 1992 is more than $159 million, up from the more than $110 million estimated for FY 1991.

DOE's two gaseous diffusion plants (GDPs), at Portsmouth, Ohio and Paducah, Kentucky, are highly power intensive. Of all the expenditures that comprise our costs of production, the purchase of electrical power is the greatest. However, the budget request for FY 1992 reflects a continuing downward trend in our power bills: $876.3 million in FY 1990, $725.2 million in FY 1991, and $668.3 million in FY 1992. This reduction is largely the result of our organized program to increase use of less expensive, nonfirm power in offpeak periods.

Other expenses related to the gaseous diffusion operations are holding generally steady, with an FY 1992 request for $368.5 million compared with last year's $364.4 million. This includes amounts for nonpower operations, construction and capital equipment.

Our FY 1992 uranium enrichment budget request provides for aggressive corrective action to improve environmental quality and resolve waste management problems. The funds we have requested for environmental activities this year exceed $120 million, more than doubling the amount we requested in FY 1989 ($60 million) and more than 36 percent above the FY 1991 request, reflecting the priority DOE is giving to cleaning up the environment. In FY 1992, the environmental program for the GDPs includes corrective actions ($21.1 million), environmental restoration ($73.1 million), and waste management ($29.7 million).

Again this year, the Department has requested Congressional approval to purchase uranium enrichment services from other suppliers when such purchases will result in a net cost savings to the U.S. Government. Because the enrichment market is price sensitive, with excess supply capacity, the Department needs additional flexibility to succeed in this highly competitive environment. With such approval, enrichment services could be purchased at prices lower than the marginal cost of production at our existing uranium enrichment plants. Accordingly, we are again requesting that Congress approve the use of appropriated funds for such purchases as opportunities arise.

In January 1990, DOE transmitted to Congress a "Plan for the Demonstration, Transition and Deployment of U-AVLIS Technology" that showed completion of a demonstration of the U-AVLIS technology in September 1992. That plan also described predeployment activities which would lead to a determination of whether to proceed with investment in, and deployment of, a production plant in November 1992 based upon market conditions at that time.

The U-AVLIS technology demonstration at Lawrence Livermore National Laboratory is proceeding on schedule. We are pleased with the technical progress being achieved. In FY 1992, DOE plans to spend $213.6 million on demonstration activities, an increase of $71.8 million -- or 50 percent -- from the $141.8 million being spent during the current fiscal year. The purpose of this demonstration is to provide for full scale testing of plant separation and laser systems, and to provide the operating, technical and economic data needed to support decisions on commercial plant deployment.

Three major milestones have recently been achieved that are critical initial steps leading to full scale technology demonstration testing:

- In March 1990, the U-AVLIS copper laser system was operated at 8000 watts. This is the highest level that has ever been achieved under routine operational conditions. This is also the power level that will be required to conduct technology demonstration.

- In June 1990, a preferred U-AVLIS feed conversion process was selected and will be used as part of the technology demonstration. This process incorporates cost and environmental improvements in converting uranium ore to metal that will be feed for U-AVLIS enrichment.

- In October 1990, the integration of laser light with the U-AVLIS separator was achieved. This represented the initial introduction of light in the uranium demonstration system that will be used for full-scale demonstration tests in December 1991.

As recently as the week of January 21, the operation of a prototype of the separator system began. It will be used in the full-scale technology demonstration. DOE plans to begin integrated testing of laser and separator systems in December 1991, and the full series of planned tests should be completed in September 1992. This effort is expected to successfully produce the technical and economic information that is required to make future decisions on commercial plant construction and operation.

In addition to our efforts in the U-AVLIS program, DOE has actively promoted legislation to transfer the Department's uranium enrichment business to a temporary Government enrichment corporation that would manage, design, construct, and operate a future U-AVLIS production plant. We had anticipated that Congress would enact legislation in 1990 to establish such a Government enrichment corporation. Regrettably, the 101st Congress did not pass such legislation.

The Administration has determined, based upon policy considerations, that the Government should avoid investments in the uranium enrichment enterprise that could more appropriately be made by the private sector. In particular, the Administration expects the new Government corporation to make the decision on the deployment of U-AVLIS. Thus, Government expenditures for U-AVLIS predeployment activities have not been included in our FY 1992 budget. Activities that will be discontinued in FY 1992 include selection of a commercial deployment contractor, implementation of an industrial access program, execution of an NRC licensing process, evaluation of candidate plant sites, and preparation of environmental impact studies.

We have reviewed ongoing FY 1991 predeployment activities in light of that FY 1992 budget decision and have found that it is not practicable or prudent to select a commercial deployment contractor, initiate an industrial access program, or start licensing discussions with the NRC if these activities will not be continued in FY 1992. Licensing activities cannot be commenced in any event, since the NRC decided in January 1991 that an applicant is required before the NRC will proceed. We have concluded that the Department should and will proceed with the identification of candidate sites for a U-AVLIS production plant and with the environmental impact studies for such sites that can be completed in FY 1991. We will soon be forwarding a letter to the Committee confirming these changes.

Looking to the future, an excess of world enrichment capacity has created a buyer's market for uranium enrichment services that will last for at least a decade. At the same time, environmental costs will continue to increase and power costs will grow due to Clean Air Act provisions. After 1995, firm contracts held by the U.S. uranium enrichment enterprise decline, requiring the enterprise to compete for more of the uranium enrichment services needed in that time frame. DOE continues to urge congressional passage of uranium enrichment restructuring legislation at the earliest possible time.

A noteworthy change in the market during the last year has been the emergence of the Soviet Union as a long-term supplier. Until recently, the Soviets have sold heavily discounted separative work units (or SWUs) primarily on the spot market. During FY 1990, the Soviets made a significant penetration into the U.S. market by signing an 8-year contract, worth about $250 million, for sales to the Yankee Group starting in 1994. The emergence of the Soviet Union as a potentially major long-term supplier represents a serious market challenge that should be addressed promptly.

Though the Administration believes that the most comprehensive and effective approach to meeting both the market and cost challenges facing the enrichment enterprise is passage of legislation to create a temporary Government enrichment corporation as an interim step toward eventual privatization, we are taking steps in the meantime to remain as competitive as possible.

First, we are devoting specific attention to the market challenge from Soviet sales of enrichment services at heavily discounted prices -- in the spot market and, particularly, in the long-term market. Conditions at this time prevent the U.S. uranium enrichment enterprise from addressing this situation from a commercial standpoint. Thus, we hope that the Soviets -- and prospective U.S. buyers -- assure that their possible transactions are fully consistent with fair trade practices in a free market. We are monitoring existing and prospective Soviet sales in the U.S. to ascertain whether fair trade practices are being followed.

Second, we have begun to make offers necessary to capture new sales in the 1996-1998 time period based on market conditions. We believe that in a free market with fair trade practices, our offers will be attractive to potential customers and will generate net revenues to the Government for that period. We are also placing emphasis on further cost reduction measures.

Let me close by returning again to the urgency of passage of uranium enrichment restructuring legislation by the Congress as the most effective means to give the U.S. uranium enrichment enterprise the greatest future commercial flexibility and competitive edge. The enterprise is a business that does not belong in the Government, where politics and the annual budget cycle all too frequently hamper effective management.

This Subcommittee, under your leadership Madam Chairman, reported uranium enrichment restructuring legislation last year. Chairman Sharp of the Subcommittee on Energy and Power agreed, during last year's budget reconciliation process, to make enrichment legislation a priority in the 102nd Congress. We are pleased to note that you have reintroduced the bill that you reported, and that Mr. McEwen has also introduced legislation. We note that Senators Ford and Johnston are continuing to spearhead efforts in the Senate. The Administration will be reintroducing its legislation shortly, demonstrating our renewed commitment to legislation. We hope that hearings will be scheduled at an early date.

We look forward to working closely with you, Chairman Sharp and others to make such legislation a reality. The long-term success of the U.S. uranium enrichment enterprise depends upon such timely and long-overdue action.

Thank you for the opportunity to appear before this Committee. I would be happy to answer questions at this time.

Mrs. **Lloyd.** Thank you, Secretary Young.

Mr. Bernero, please proceed.

STATEMENT OF ROBERT M. BERNERO, DIRECTOR, OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS, NUCLEAR REGULATORY COMMISSION

Mr. **Bernero.** Thank you. Madame Chairman and members of the subcommittee, I am pleased to be here today to testify on possible licensing of uranium enrichment plants using the AVLIS process.

I would like my statement entered into the record.

Mrs. **Lloyd.** Without objection, that will be included in its entirety.

Mr. **Bernero.** I would just like to simply paraphrase it and get to the essence of the statement.

Mrs. **Lloyd.** Very good.

Mr. **Bernero.** Uranium enrichment legislation was discussed in the Congress late last year. There was an Act, the Solar, Wind, Waste and Geothermal Power Production Incentive Act of 1990 passed, which has a great impact on how any uranium enrichment plant would be licensed in the United States.

The essential change of such facilities would no longer be subject to the two-stage developmental type licensing process that had been used in the past for nuclear reactors and would have been used for uranium enrichment plants.

In contrast, and my statement goes into some detail on this, this new legislation puts us into what we call a materials license operation—a one-step licensing in which a presumably complete design would be reviewed and an environmental statement prepared and published and a decision on licensing made before the plant is constructed. So it is slanted, if anything, toward developed technology.

At this time, we are, in fact, reviewing a privately proposed uranium enrichment plant using gas centrifuge technology, the Louisiana Energy Services application. The application for that license will follow these new procedures deriving from the recent act.

In contrast with that, the AVLIS technology is not as familiar to the parties involved—to the NRC and our safety analysts. It constitutes a new technology, a major advancement in enrichment technology with many new licensing issues. We recognize and have tried to come up with an understanding of the complexity of the issue. We have met with DOE on a couple of occasions to learn more about the process, but we recognize that it would be a very substantial effort.

We have, at this time, no resources in our budget set aside for learning or for conducting licensing review and to further complicate matters in this time of constant budgets, this fiscal year, the NRC has undertaken for the first time to achieve 100 percent recovery of our budget authority through fees.

So the NRC is faced with a significant question of resources in facing the prospect of reviewing a complex new technology such as AVLIS. To put it simply, we have right now neither the authority, since it is a DOE project, nor the resources, because they are not in our budget to review AVLIS and therefore, see real difficulty in undertaking such a review in the near future.

Thank you. I would be happy to answer any questions.

[The prepared statement of Mr. Bernero follows:]

PREPARED TESTIMONY
SUBMITTED BY
UNITED STATES NUCLEAR REGULATORY COMMISSION

TO

SUBCOMMITTEE ON ENERGY
COMMITTEE ON SCIENCE, SPACE AND TECHNOLOGY
UNITED STATES HOUSE OF REPRESENTATIVES

CONCERNING
ATOMIC VAPOR LASER ISOTOPE SEPARATION (AVLIS)

PRESENTED BY
ROBERT M. BERNERO
DIRECTOR, OFFICE OF NUCLEAR MATERIAL SAFETY
AND SAFEGUARDS

SUBMITTED: APRIL 10, 1991

Madam Chairman and members of the Subcommittee, it is a pleasure to be here today to discuss the Nuclear Regulatory Commission's (NRC) views on possible licensing of uranium enrichment plants using the atomic vapor laser isotope separation (AVLIS) process.

In my appearance last year before a subcommittee of the House Committee on Interior and Insular Affairs I presented testimony concerning uranium enrichment legislation. Legislation which affects how uranium enrichment plants are to be licensed was passed in the last Congress and became law. Today's presentation concerns the narrower topic of a particular new technology being developed for the enrichment of uranium, that of Atomic Vapor Laser Isotope Separation or AVLIS. In presenting the NRC's views on possible licensing of uranium enrichment plants which use AVLIS technology, it is important to identify the changes in legislation which affect the licensing of enrichment plants.

On November 15, 1990, the "Solar, Wind, Waste, and Geothermal Power Production Incentives Act of 1990," became Public Law 101-575. It contained Section 5 entitled "Licensing of Uranium Enrichment Facilities," which amended several provisions of the Atomic Energy Act (the "Act"), adding a new Section 193 and amending Section 161. The legislation amended the Act to remove uranium enrichment facilities from consideration as production facilities for the purposes of Chapters 10 and 16 of the Act. However, such a facility remains a production facility for other purposes of the Act, including controls on exports of sensitive equipment and preservation of Federal preemption. The result is that a license application for a uranium enrichment facility will be subject to the licensing provisions of the Act for source and special nuclear materials. This change means that applications for such facilities are not now subject to the two stage licensing process applicable to power reactors. This change also eliminates the need for prelicensing antitrust review and operator licensing.

Section 161b. of the Act was amended to give the Nuclear Regulatory Commission discretionary authority, exercised by rule or order, to establish any conditions it deems appropriate in regard to ownership, control, or possession of uranium enrichment equipment in order to protect the common defense and security. This gives the Commission authority over enrichment equipment, such as gas centrifuges or laser separators, equivalent to the authority it would be able to exercise under Section 103 of the Act, as implemented by 10 CFR Part 50, the rule governing nuclear reactors. However, the statutory prohibition in Section 103, against licensing any activity owned, controlled, or dominated by a foreign entity would not apply. The Act was also amended to provide for criminal penalty authority for sabotage of licensed uranium enrichment facilities.

Four major areas are addressed in the new Section 193 of the Act: hearing provisions, timing of actions, environmental review, and preoperational inspection as follows:

o There must be an adjudicatory hearing on a single license for construction and operation even if none is actually requested, but only one hearing is required. NRC requirements in 10 CFR Part 2 Subpart G provide procedures for NRC adjudicatory hearings that are "on the record."

- An Environmental Impact Statement (EIS) must be prepared by the NRC before the licensing hearing is completed.

- Two provisions address timing. As noted, an EIS must be completed before the completion of the hearing. Secondly, the single license to allow construction and operation cannot be issued until the hearing is completed and a decision issued.

- Prior to commencement of operation, the Commission must verify by inspection that the facility has been constructed in accordance with the license. A notice of the inspection results must be published in the Federal Register. Because Section 193 stipulates that only a single hearing is required to authorize operation, the notice of inspection results does not provide a basis for a hearing.

New Section 193 of the Act also covers two financial aspects, public liability and decommissioning. Although no government indemnification under Section 170 of the Act is to be provided (i.e. no Price Anderson coverage), the licensee must carry public liability insurance against similar risks. Section 193 requires the insurance to cover the risks of chemical compounds containing source or special nuclear material, thus specifically including the chemical toxicity risks associated with uranium hexafluoride, for example. Financial assurances for decommissioning costs are required in basically the same form as required by the Commission's decommissioning funding rules.

The NRC staff is presently working within this new framework on the review of an application from Louisiana Energy Services for a gas centrifuge enrichment facility. It is important to note that the NRC staff has had considerable experience in the review and evaluation of many applications for licenses for both reactors and nuclear materials, including several fuel facilities producing and handling bulk uranium hexafluoride. The safety issues for these facilities and for centrifuge enrichment facilities are quite similar. The centrifuge technology is well established and the NRC staff has visited Europe and become familiar with an operating enrichment plant with virtually identical centrifuge machines. This experience forms a sound basis for our review and evaluation of the license application.

In contrast with the situation for gas enrichment technology, and its inherent safety considerations, AVLIS constitutes a major departure from production scale enrichment technology for which several new licensing issues arise. For example, AVLIS technology does not utilize the gaseous uranium hexafluoride, but utilizes melted and vaporized uranium metal instead. Enrichment factors are much larger and raise significant questions regarding potential for criticality accidents and unauthorized material production. The laser systems themselves raise additional safety concerns with respect to the use of organic fluids at elevated pressures, as well as dye toxicity.

Under the Atomic Energy Act the NRC has no authority to license DOE's Atomic Energy Act activities, except for certain specifically identified activities, such as a high-level waste repository. If the Congress wishes the NRC to license DOE's AVLIS activities, it would have to enact specific legislative authority for the NRC. As an alternative, DOE could transfer the technology to a private entity, which would then be subject to NRC regulatory control.

As I have already indicated, an NRC review of an AVLIS plant would be a major undertaking, involving new, less familiar safety issues compared with previous staff reviews. In addition, NRC does not currently have the resources to conduct a license application review or to conduct necessary prelicensing consultations. Further, starting this fiscal year the NRC is subject to a Congressional mandate to achieve one hundred percent recovery of its budget authority through its fees. Under current legislation, NRC could not recover any AVLIS review costs unless DOE voluntarily agreed to reimburse the NRC.

The present state of AVLIS development is also a key consideration in understanding the timing for possible application and NRC review. In order for the NRC staff to perform an efficient and timely review and come to a satisfactory conclusion on safety and environmental issues, any application tendered must provide virtually complete consideration of site selection, site suitability, and include an essentially complete plant design. The absence of sufficient final design information for review would inhibit early licensing of an AVLIS plant.

In summary, the NRC has neither the authority nor the resources at present to review and evaluate an AVLIS plant. If the NRC were to be so authorized, it is only prudent to point out that the review would involve safety topics new to the staff, and there is the possibility of a contested licensing proceeding.

Because of these considerations, we cannot presently provide any reliable estimate of the time required to complete review and licensing.

This concludes my statement. I would be pleased to respond to any questions that you and the Subcommittee may have.

Mrs. LLOYD. Thank you, very much.

Mr. Rezendes, please proceed.

STATEMENT OF VICTOR S. REZENDES, DIRECTOR OF ENERGY AFFAIRS, GENERAL ACCOUNTING OFFICE

Mr. REZENDES. Thank you, Madame Chairman.

As Mr. Young pointed out earlier, the Administration's 1992 budget anticipates that the new Government corporation, not the Federal Government, will complete AVLIS.

While the budget provides for completing the demonstration, it does not contemplate funds for program activities such as site selection which must be completed before we construct AVLIS.

I would like to focus my testimony to just briefly summarize some of the obstacles that we see that need to be overcome as a Government corporation or anyone would need to understand before they complete the AVLIS project.

First, I think we need to adequately demonstrate on a full scale with equipment a convincing cost projection.

Secondly, we must integrate the fuel cycle. Right now, the AVLIS system uses a metal fuel, uranium cycle whereas currently existing companies use a gas process.

If DOE's demonstration ends in 1992, several unanswered technical questions will prevent DOE from completing a definitive cost analysis which a Government corporation or a private corporation will need to do before it decides to invest in the AVLIS.

Additionally, there are site selection problems and plant licensing problems which could take years to complete.

Finally, a marketing analysis would probably have to be done to take into consideration the changing marketing conditions that are out there, especially new construction of possible new nuclear plants and additional competition from overseas.

We believe completing the AVLIS demonstration project would provide important information on technical viability and cost of the plant and keep the AVLIS option open.

Further, completing the demonstration project would increase the probability of private financing and the likelihood of DOE realizing its return on $1 billion investment in AVLIS. DOE may not be able to completely answer all the technical issues by the end of 1992, however. A new Government corporation, if formed, would have to complete these activities before it decides to build AVLIS.

Finally, we can't separate the AVLIS program from the existing legislative attempts to restructure the uranium enrichment program. We have long supported that legislation. We think it is the better way to go.

We also agree that transferring AVLIS to the private sector or the private Government is also the most appropriate decision also, because that would force private investors rather than the Congress to make decisions based on the competitive nature of the industry to proceed with the AVLIS program.

That concludes my statement.

[The prepared statement of Mr. Rezendes follows:]

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URANIUM ENRICHMENT

GAO's Views on DOE's New Laser Enrichment Technology--AVLIS

Statement of
Victor S. Rezendes, Director
Energy Issues
Resources, Community, and Economic
Development Division

Before the
Subcommittee on Energy Research and
Development
Committee on Science, Space, and
Technology
House of Representatives

GAO/T-RCED-91-21

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Madam Chairman and Members of the Subcommittee:

We are pleased to present our views on the Department of Energy's (DOE) program to develop a new uranium enrichment technology--the atomic vapor laser isotope separation process (AVLIS). Our views are drawn from GAO's ongoing review of AVLIS, in which we are looking at the technical, program, and market issues that need to be addressed before an AVLIS plant is built.

DOE's January 1990 AVLIS demonstration and deployment plan outlined DOE's efforts to (1) demonstrate the technology by September 1992; (2) begin construction in 1993, if the Congress authorizes building a plant; and (3) have an AVLIS plant begin enriching uranium by 1997. However, the administration's recently proposed 1992 budget anticipates that a new government enrichment corporation and/or the private sector, not DOE, will build the AVLIS plant. Therefore, the budget provides funds for completing the demonstration of the AVLIS technology but does not contemplate funding project activities, such as site selection, that must be completed before a plant can be built.

In summary, we identified a number of steps that must be completed before an AVLIS plant can be built.

> The AVLIS process must be adequately demonstrated with full-scale equipment and convincing cost projections must be developed. In addition, the processes for efficiently

integrating an AVLIS plant, which will use and produce uranium metal, with existing nuclear fuel companies, which use uranium gas, must be demonstrated. If DOE's demonstration ends in 1992 as planned, several unanswered technical questions will prevent DOE from completing a definitive cost analysis, which the government corporation or a private company will need before it decides whether or not to invest in a plant.

-- Program activities, such as selecting a site and completing the plant licensing process, that must be completed before a plant is built, could take many years. Accordingly, a new government corporation, if and when it is formed, would have to complete these activities before building a plant.

-- A market analysis that updates and expands DOE's existing analysis should be completed before any decision is made about building an AVLIS plant. Such an analysis needs to consider the impact of possible new nuclear plants and competitors' sales strategies.

Completion of the demonstration project is needed to keep future AVLIS deployment options, such as construction by a new government corporation or a technology transfer agreement with a private company, open. The technical and related cost and market information developed by completing the demonstration would enhance a new government corporation's ability to deploy AVLIS in a timely and efficient manner and assist private investors in making sound decisions about building a commercially viable plant. However, the Congress should recognize that DOE will not be able to completely address all remaining deployment issues by the end of 1992.

Before I discuss these issues in more detail, I will briefly describe DOE's current enrichment program and the AVLIS technology.

BACKGROUND

Since 1969, the federal government has enriched uranium for use as fuel in commercial nuclear power reactors at gaseous diffusion plants, built in the 1940s and 1950s for defense purposes. Currently, DOE's program faces financial difficulties caused by growing competition from foreign suppliers and many other problems, such as the need to clean up the plants to meet environmental requirements and the need to collect funds to decommission the plants when they are no longer needed.

In 1973, DOE's Lawrence Livermore National Laboratory began conducting research on AVLIS. An AVLIS plant will enrich uranium for commercial reactors using (1) lasers that charge the specific uranium atoms needed to sustain nuclear reactions and (2) separators that vaporize natural uranium metal and then collect the charged atoms on electromagnetic plates. Subsequently, the enriched metal will be processed and shipped to nuclear fuel companies, that will fabricate it into reactor fuel.

In 1985, DOE decided that an AVLIS plant would eventually replace its energy intensive gaseous diffusion plants because the agency expected an AVLIS plant to produce enriched uranium at less than half the cost of the existing plants--perhaps, as low as $25 per production unit, compared to DOE's current cost of about $70 to $80 per unit. However, DOE will have to continue operating part of one diffusion plant even if an AVLIS plant is built, because the AVLIS plant, as currently designed, would not be able to produce the highly enriched uranium needed for defense purposes. DOE officials believe that its two operating gaseous diffusion plants can continue to operate for 20 or more years.

For the past several years, the administration has proposed and GAO has supported the creation of a government corporation that would assume responsibility for the DOE enrichment program, including AVLIS. DOE officials believe that a government corporation would better manage the existing program in a competitive market. They also believe that a government corporation is a necessary first step toward the long-term goal of transferring the program to the private sector. Under the administration's proposal, the new corporation would take over DOE's operating enrichment plants and be responsible for supplying enriched uranium for defense needs, as well as DOE's commercial customers.

A NUMBER OF TECHNICAL PROBLEMS MUST BE ADDRESSED TO REDUCE AVLIS COST UNCERTAINTIES

The Lawrence Livermore Laboratory has effectively demonstrated the AVLIS technology using laboratory-scale equipment and independent technical experts hired by DOE to critique the AVLIS program believe that DOE's ongoing demonstration program will also prove that the technology works using full-scale equipment. However, those same experts agree that the demonstration will not provide definitive cost information by 1992, as originally anticipated in DOE's 1990 demonstration plan, because some remaining technical issues could have significant cost implications. For example, although the Lawrence Livermore Laboratory is continually improving laser performance, DOE does not expect to develop or operate by 1992, lasers that are as powerful and efficient as those projected for use in the AVLIS plant. Laser efficiency is a key cost element for an AVLIS plant. Further, the demonstration program will not actually enrich uranium until mid-1992. This will not provide enough time to operate the full-scale separators long enough to determine optimal materials and maintenance requirements before the scheduled end of the demonstration project.

In addition, questions about how an AVLIS plant will be integrated with existing nuclear fuel companies will remain at the end of 1992. Existing fuel cycle companies currently convert uranium ore to a gas feed for DOE's existing enrichment plants and then fabricate enriched uranium gas produced by DOE's plants into fuel for nuclear utilities. Because the AVLIS plant will use uranium metal as a feed and also produce enriched uranium in a metal form, changes to the fuel cycle will be needed to accommodate an AVLIS plant. Although DOE did not begin to coordinate with fuel cycle companies until after 1985, it has identified processes it believes will allow the plant to effectively interact with existing fuel cycle companies. However, DOE will not have demonstrated these processes by 1992, nor will it have decided if and how it will transfer these processes to the private sector.

PROGRAM TASKS NEED TO BE COMPLETED BEFORE AN AVLIS PLANT CAN BE BUILT

Our review also showed that a number of program activities that must be addressed before a plant is built may take a considerable amount of time. These program activities include selecting a plant site, completing a Nuclear Regulatory Commission (NRC) license review, and establishing an industrial access program to encourage private companies to participate in the program, with the objective of obtaining expertise for deploying the technology in a commercial plant. In particular, the process for the NRC license review could be very time-consuming. NRC has not yet planned to direct any resources to an AVLIS license review. Further, according to NRC staff, such a review could take much longer than the 2 years DOE's plan anticipated, because very little data exists on the unique, new AVLIS technology. DOE officials also told us that selecting a site and preparing the required environmental impact statement may prove controversial and time-consuming.

Under its 1992 budget, DOE plans to cease all program activities for a future AVLIS plant. Accordingly, a government corporation, if and when it is formed, would have to complete them before building a plant.

MARKET CONDITIONS CLOUD THE FUTURE OF AVLIS

The current enrichment market is different from the one that existed when laser separation research began in 1973. Today, annual production capacity in western countries exceeds demand by about 25 percent, and, if production by the Soviet Union is included, capacity exceeds demand by over 60 percent. In addition, only a few countries are building new nuclear power plants, and some energy experts do not expect any new U.S. plants to be completed until after the year 2010.

An updated and expanded analysis of the enrichment market will be needed to lay out the advantages and disadvantages of building an AVLIS plant in order to attract private investors. Initial market analyses of a future AVLIS plant have had mixed results. The Lawrence Livermore National Laboratory reports that an AVLIS plant would save the current program $500 million to $800 million per year because of reduced production costs; therefore, the Laboratory has concluded that an AVLIS plant should be built as soon as possible. However, DOE's independent technical experts and others believe that the laboratory's estimates of $25 per production unit and $1 billion for construction are probably too low; further, the Laboratory's analyses did not consider dynamic market factors such as a continuing aggressive sales strategy by the Soviet Union. (Over the past several years, the Soviet Union has penetrated the U.S. market by offering enrichment services at less than half the cost of DOE's current $117 price.) DOE's initial market analyses that consider these factors suggest that under such conditions, an AVLIS plant would not increase sales enough to recover construction costs.

Further, the longer an AVLIS plant is delayed, the more a complete market analysis will have to consider the demand from future nuclear power plants to recover costs. New nuclear plants may or may not be built depending on how the nation resolves a growing demand for electricity and the environmental problems associated with coal- and gas-fired plants. However, DOE believes that lead time will be adequate to satisfy future enrichment demand. DOE estimates an AVLIS plant could be built in 4 to 5 years after needed program activities are completed, while, historically, building a commercial nuclear power plant has taken at least 8 to 10 years.

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In summary, we believe that completing the demonstration project would provide important information about the technical viability and cost of the plant and keep future AVLIS deployment options open. Completing the demonstration project would also reduce construction delays and increase the probability of private financing. Further, if the private sector supports the plant, DOE is more likely to reap a return on its past investment in AVLIS. However, the Congress should recognize that DOE may not be able to completely address all technical issues by the end of 1992, and a new government corporation, if formed, would have to complete program activities before building a plant.

We also note that the future of AVLIS cannot be debated separately from existing legislative attempts to restructure DOE's uranium enrichment program as a government corporation. We have long supported such legislation, which we believe would allow the program to be better managed in a competitive market. We also support DOE's goal to transfer AVLIS to a government corporation. This would require the new corporation to convince private financiers, instead of the Congress, to invest in AVLIS, which would reduce the government's risk and help ensure that the decision to build an AVLIS plant is based on commercial concerns.

We hope our views and suggestions are useful to you. We would be pleased to respond to any questions you or other Members of the Subcommittee may have.

Mrs. LLOYD. Thank you very much, gentlemen, for your testimony.

Secretary Young, as Mr. Rezendes has pointed out, there are still a lot of deployment activities that really need to move ahead. Since we have put as much money as we have into the program, it sort of gives the impression at this point that we put about $3 billion in a GCEP and walked away from it. It sort of gives us the impression that DOE has decided to shelve this technology. Would you like to comment on that?

Mr. YOUNG. I would say most emphatically that we have not decided to shelve the technology. I think our belief in the prospects for the technology, both technologically and economically, are illustrated by our commitment of an additional $71 million in Fiscal Year 1992 to complete the demonstration. This technology demonstration has been proceeding according to schedule. It has been achieving the kinds of results that were expected. We have every reason to believe that the demonstration will be successful. So we are strongly supporting completion of the demonstration.

I think at the same time the Administration is also saying most emphatically that we have a general belief that the uranium enrichment enterprise should be spun off into the private sector as soon as possible through a temporary Government corporation as the vehicle for most effectively doing that. We have made a policy decision, again, not because of lack of belief in AVLIS, but to make the point that private sector investment is the proper vehicle for commercializing or proceeding with a production plant for this technology.

Mrs. LLOYD. Secretary Young, certainly we agree with you. I was a sponsor of a bill. Mr. Morrison sponsored the bill to move ahead with restructuring of the uranium enrichment corporation. So we agree with you.

At the same time, as I discussed with you earlier, if this Government corporation is not created, aren't we hampering this corporation by delaying these activities that Mr. Rezendes said are essential, such as greater understanding of the technology and cost estimates and moving ahead with some licensing activities? Aren't we making this a little bit more expensive by delaying this part of the program?

Mr. YOUNG. I think we are certainly delaying the potential date for initial application of the technology. I think the demonstration expense would continue as it would be. I think the Administration is accepting this short-term impact on the time frame of the technology in the hope of achieving this Government corporation that will be able to then proceed to implement the technology as early as possible.

Mrs. LLOYD. In all candor, Secretary Young, really, what is DOE doing to promote passage of these legislative proposals other than testifying before the committees? You know, there is another committee where there is really a major log-jam. What is being done to move the restructuring?

Mr. YOUNG. Well, I think we are having contacts with other committees that are involved in this.

Mrs. LLOYD. Do we have a commitment at the Department that you are going to aggressively push the corporation this year?

Mr. Young. Yes. We have a commitment from the Department that we are going to aggressively push it. We are. We have met with members that are key to proceeding in the House on this. We testified this morning before Congressman Sharp's subcommittee in support of this.

Mrs. Lloyd. I would urge you to really work hard with this restructuring legislation.

Why is DOE writing another bill? I was rather curious about that.

Mr. Young. We decided, perhaps somewhat belatedly, to update the bill before putting it forward to the Congress. It is taking longer than we had hoped in the review process to move forward.

Mrs. Lloyd. Will yours reflect any of the Smith-Barney report recommendations?

Mr. Young. Possibly. That is one of the items under discussion within the Administration.

Mrs. Lloyd. Another issue I wanted to get into with you is that last year, as you know, DOE wrote a request for deployment contract, an RFP. But if my memory serves me correctly, this was never issued. Is that correct?

Mr. Young. Yes, ma'am. We have prepared the paperwork, the Request For Proposal.

Mrs. Lloyd. That hasn't been issued, yet.

Mr. Young. No. The reason is that at about the time that we were ready to issue it, this question came along of the Administration's policy on the Fiscal Year 1992 budget. You cannot go out and select a contractor in this fiscal year; then if the Administration's budget proceeds, terminate that contract at the start of the next fiscal year. So it really is not practicable under the budget policy we have established to proceed to select a contractor.

Mrs. Lloyd. I know that OMB took the money out, but at the same time, I think it is pretty obvious from the other testimony today that we are going to have to have industry participation at this point.

What are you going to do with the money for that, Mr. Secretary, for the pre-deployment activities that have been appropriated?

Do you plan to reprogram this funding?

Mr. Young. We have a letter that is in review in the Administration. There are only a few million dollars that would require reprogramming. Our intention would be to apply that to the demonstration to move that along. We would be proceeding, as I indicated earlier, with the site evaluations at least for the remainder of this Fiscal Year the environmental studies.

Mrs. Lloyd. Mr. Bernero, why did the NRC decline to begin the licensing review of the AVLIS technology. It was my understanding that at some point, DOE even offered to fund it and still you declined it.

Mr. Bernero. Well, the situation was that we did an evaluation last summer. Then DOE came out and gave us excellent support for a major review meeting of just what is here? What might AVLIS' review constitute?

Afterward, we discussed with the Commission the apparent size or scope of the project. I believe it is quite public now that since about last September, we advised the Commission that it would take us something on the order of a quarter million dollars just to get a reasonable estimate of what it would take to review AVLIS.

The Commission, as a result, is at this time recognizing that we are in a fixed budgetary and resource short situation, and said we will monitor this activity at a very modest level, but certainly nothing like licensing review. Basically, we don't have the resources and we don't have the authority for that matter, although that could be worked out, I am sure.

Mrs. LLOYD. If we gave DOE the money to do this, would you move forward with it?

Mr. BERNERO. As I said before, if one simply stipulated that somehow we could work out a legal arrangement——

Mrs. LLOYD. If you would be paid for it.

Mr. BERNERO [continuing]. To get paid. That doesn't put people under my direction to do a review. I would have to basically sit down with our existing program, and take money, take resources away from some other activity from material licensing——

Mrs. LLOYD. I am asking you if you were just given the money to do it, Mr. Bernero?

Mr. BERNERO. But I have to have the money appropriated.

Mrs. LLOYD. In other words, it would take an action from Congress.

Mr. BERNERO. Yes. It would take the budgetary action of Congress. Otherwise, all I could do is appropriate where I get consent, I would have to reprogram existing resources.

Mrs. LLOYD. Mr. Young, would you like to respond to that?

Mr. YOUNG. May I comment on that? We at DOE are quite prepared to pay the fees that would be required to have the NRC commence these activities. I think we feel that we have the appropriations to start that. We also, I think, as Mr. Bernero has indicated, worked extensively to help identify the kinds of technical expertise that should be developed to review these applications.

Again, here we have a situation where if we are going to stop at October 1, 1991, then we have a problem starting that process.

Mrs. LLOYD. For my information, as well as for the record, what is DOE doing right now to move forward with the licensing issue?

Mr. YOUNG. I guess we're trying to figure out a way to do that. Basically, the response from Chairman Carr said that unless we had an applicant, that the Commission would not proceed with the reviews. I think the applicant would be the Government corporation. We do not see the Department.

Mrs. LLOYD. In other words, we really are not doing anything right now.

Mr. YOUNG. Yes, ma'am.

Mrs. LLOYD. Mr. Rezendes, do you think the private sector or the enrichment corporation or—really, who are the appropriate agents to generate the assessments that you mentioned in your statement to base your construction decision, the economic decision and market decision?

Mr. REZENDES. Basically, we feel that kind of information needs to be done whether the Government builds this, private industry builds this or a Government corporation.

The next question, then, is the speed with which you want these things done. If to be competitive, as we know how the contracting of the utilities is working out, and if you want AVLIS up and running by the Year 2000, then obviously the sooner these questions are answered and these uncertainties resolved, the better.

It is easier to complete this information, put it on the shelf and then decide, even in five years, to build AVLIS if, in fact, the market conditions aren't ready now. The sooner you know these things, the greater speed with which you could act when, in fact, it does become important to act to build AVLIS.

Mrs. Lloyd. One thing in your statement, I notice that you criticized the demonstration because it was not using plant scale equipment and that the lasers and separators weren't to scale.

Now, Dr. Davis, who is going to testify a little bit later, says that they are the same size that will be used in the commercial plant. I would like for you to explain your position.

Mr. Rezendes. We were not aware that they were full size.

Mrs. Lloyd. Would you like to comment on that, Mr. Young.

Mr. Young. Yes, ma'am. We will be testing plant scale equipment in the demonstration. I think the question is how far up in performance of that equipment you need to go to establish a confidence that the performance level and the production plant would be satisfactory and economic.

The demonstration program has been carefully devised to take a whole series of individual technological demonstrations of elements of the process and bring them to a point where the best experts are responsible for the program, and two sets of independent experts have reviewed the decisions, have concluded that there will be sufficient performance demonstrated to reach a conclusion that deployment of a production plant would be prudent.

I might add that along with that demonstration process, there are certain other things that are being brought along in a side stream, off-line, if you will, to add further to the information that will be available as you proceed with deployment.

One of the first things that you do and the most essential thing to do in getting this technology applied as early as possible is to develop a design, develop the paperwork. We see that at the completion of demonstration, there will be ample information and confidence to proceed with that design.

As you finish that paperwork, you get confirmation from further testing that you are making a prudent decision to minimize the time to get to a production plant. This is quite common in all development and application programs. You don't finish every development step before you proceed with the paperwork and the design work to advance the project.

Mrs. Lloyd. Thank you. Mr. Morrison.

Mr. Morrison. I still don't understand precisely the limitations on NRC, other than financial. I understand the limitations on dollars.

Mr. Bernero, you indicated that you felt that you really lacked the authority to proceed with the work with the Department of Energy on the AVLIS technology. Is that accurate?

Mr. Bernero. Yes, that's accurate if one is speaking of licensing. A licensing review, we lack the authority. A technology review, we do not lack the authority. Presuming when the Department of Energy has offered to fund that, it would be some sort of license ability review. There wouldn't be a lack of authority there.

Mr. MORRISON. So I presume this ties in, then, with the interface between AVLIS, the technology and enrichment, the enterprise?

Mr. BERNERO. Yes. Yes, indeed. Who is the agent is very significant to us. We have done license ability reviews in the past. If you are familiar with the Fast Flux Test Facility Reactor in Washington.

Mr. MORRISON. Yes. I have heard of it.

Mr. BERNERO. We did a license ability review of that in anticipation of doing a licensing review of Clinch River Breeder Reactor.

Mrs. LLOYD. I have heard of that, too.

Mr. MORRISON. If in this same relationship, if there was a private sector deployment contractor in place, would that give you a potential licensee?

Mr. BERNERO. Yes, indeed. A private company applying for a license, of course, they would have to have some right to the technology. Certainly, there is classified material here. The rights to the technology and all that would have to be in order. But a private enterprise with the appropriate authority could be an applicant for a license. There would still be the major burdens, that I spoke of, of complexity. The present legislation makes it one-stop, final design licensing that isn't too amenable to this advancing technology.

Mr. MORRISON. I think we are probably——

Mr. BERNERO. But licensing authority would certainly be there.

Mr. MORRISON. I would guess as I tried to step back and look at this we've got two tracks going and it is where they come together that gives you the opportunity. It is also where, of course, we finally marry the AVLIS technology and its development with a new structure, hopefully, the enrichment enterprise.

I guess I would just say that I am confident the subcommittee would be more than eager to help create the opportunity for you to be comfortable with proceeding with the evaluation of the technology, Mr. Bernero, and of course ultimately to the licensing.

I wanted to ask Secretary Young if there is potentially a study being done which considers closing one of the gaseous diffusion plants and operating only one of them.

Is such a study in existence?

Mr. YOUNG. I am not aware of a formal study. We have from time to time looked to check that continued operation of two plants was the most economic way to produce SWU's. We have reached that conclusion continuously. There is no study about closing one of the plants.

Mr. MORRISON. So the only way this would be considered would be if, in fact, orders went down, electrical costs went up, all of the factors that you would normally just measure on a day to day basis?

Mr. YOUNG. We have contracts that run out through the late 1990s through 1999. We have, for example, up through 1995, a 12 million SWU, roughly, based for production. In the 1996 through the 1998 time frame, that guaranteed base drops to roughly 8 million SWUs per year. Even at that level, operation of two plants is the most economical way to supply our customers.

We also have out at this time incentive price offers to seek additional contracts for that period of time. So during the 1990s, the existing guaranteed and prospective contract level is such that we see operation of both plants as being the right way to produce SWUs most economically.

Mr. MORRISON. But after that, SWUs are $25, thanks to AVLIS. It is the way to go.

Mr. YOUNG. Yes, sir. Sometime early in the next century, we would envision phasing in AVLIS and phasing out the diffusion plants.

Mr. MORRISON. Thank you, Madam Chairman.

Mrs. LLOYD. Mr. Wolpe.

Mr. WOLPE. Thank you, very much, Madam Chair. I am still kind of struggling with this whole question as to the economics of underpinning the proposed investment in AVLIS technology. I understand that if one sets a goal that by the year 2000 you want it online, there are certain things that must be done.

It seems to me the more relevant question is: Should it be done? That is the thrust of the questions that I would like to pose.

First of all, Mr. Young, when will the technology demonstration be completed?

Mr. YOUNG. The technology demonstration will be completed in September 1992. There will be some continuing further testing that goes on to add further data to the information to be used in the application of the project, but we believe that the technology demonstration by September 1992 will form a sufficient basis for a deployment decision.

Mr. WOLPE. When you talk about the technology demonstration being essentially completed, does that include the actual production component such as the separator, the lasers and the optical systems that would be in the operating facility in 1992?

Mr. YOUNG. It depends. For the separators, yes. It would include one of the three pods that would be used for the laser system.

Mr. WOLPE. Not for the other two pods?

Mr. YOUNG. As I recall, the demonstration involves one pod whereas you use three for a production plant. I may be wrong on that, but that is my recollection. I mean it is a full scale size; it is only a question of the number.

On the lasers, the demonstration would be done with the precise characteristics of the lasers that would be used in the production plant. We would carry through the demonstration integrated procedure using a set of lasers that have been planned to be used. We are in parallel, bringing along a laser system that we expect to have higher performance efficiency, if you will.

I think the point here is that both will produce the same characteristic light and interaction with the uranium. It is only a question of how efficiently it does that in the process.

Mr. WOLPE. What do you mean only a question of? Isn't that a pretty vital element of what was at stake here?

Mr. YOUNG. I think we believe that the demonstration is quite sufficient with the lasers that are planned. It will achieve demonstration at a level very near the plant performance.

Mr. WOLPE. How about the optical systems?

Mr. YOUNG. Pardon me?

Mr. Wolpe. How about the optical systems?

Mr. Young. The optical systems—again, this is a case where we have an optical system that will assure that we get laser light to the separators to enrich uranium. For a production plant, we contemplate using a more advanced optical system, fiber optics that is also being brought along. We do not see that as a significant development question.

Mr. Wolpe. Isn't the bottom line that you, in fact, will not have demonstrated by September of 1992 a facility that is identical to the one you will be planning to build and operate. The reason for the very substantial research dollars to be spent in the out-years beyond 1992 is because you still have a lot of questions that you still have to have answered.

Mr. Young. The answer is yes. The demonstration will not be the identical system that would be built in a production plant. The demonstration was carefully defined and developed to demonstrate, at a sufficient level, those individual features of performance that are important to technological and cost success.

From that performance, we would project the production plant performance and we would then be confirming shortly after the demonstration the further information on that. This is not uncommon in development. You do not necessarily build an identical device for a production plant. You build a device that proves critical performance and you base your projections on that by extrapolation.

Mr. Wolpe. Though, if there is not some question as to whether or not these critical components have not been fully tested, whether a private corporation would be able to raise money in the market for that development.

Mr. Young. The decision on how to cast the demonstration was made by a set of experts within the Lawrence Livermore lab and on the basis of the most effective use of funds for the Government. It has been reviewed by personnel not only from other laboratories but from industry and from universities. So we believe that we have independent confirmation from experts that the decision of just what to demonstrate is a sound one.

Mr. Wolpe. I understand that is your judgment. That wasn't my question, though. The question was whether, given the outstanding nature of the questions that will yet have been asked much less answered, why are we so confident that a private corporation would be able to raise the money in the market?

Mr. Young. I think we are confident because they would use the same kind of technical expertise that we are to reach their conclusions and projections; that they will see that the results of the demonstration have brought the technology to a very low state of uncertainty, such that in their own interest, proceeding with a plan for deployment would be prudent.

I think they would certainly see the prospect for much improved economy and production and much improved revenue compared to what we have right now.

It would also see that they could proceed with a relatively low-cost work while these further sets of information were being developed to confirm the projections before they had to make a significant commitment of funds.

Mr. WOLPE. Could I ask the GAO for its judgment as to the conclusion of what kind of uncertainties would still exist at the end of 1992 and how long it would take to resolve those unresolved issues?

Mr. REZENDES. I think your line of questioning is exactly on target. That is basically the thrust of the GAO testimony here. We are not questioning whether the technology works or not. We think it does. We think there is a general scientific agreement that AVLIS is a viable technology and will produce enriched uranium at much cheaper costs than the current system.

But the real question and the unanswered questions we have is that if you are going to ask a private investor to come forward with cash to build one of these plants, there is still a lot of uncertainties that the business world would want resolved, rather than from a scientific perspective.

For example, although the lasers are the same size in a demonstration project now, they are not the advanced lasers that would be used in production.

We talk about the separators. The separators haven't been fully tested to develop maintenance and cost that the private sector would need to know to have a degree of assurance of what it is going to cost to put their money on the line. That is the distinction we are making here.

Mr. WOLPE. A concern that I have is that it seems to me that I don't think we can have it both ways. On the one hand, you can't have a deployment plan call for a research and demonstration activity all the way through 1992 when the plant is to be built and you can't tell us that you have enough information on the viability of the system in 1992 to make that deployment decision; and yet also tell us that you are going to have to continue the research up through 1997, at least, to have an adequate answer to know what we are doing.

Mr. YOUNG. May I comment, please?

Mr. WOLPE. Sure.

Mr. YOUNG. First of all, the research does not continue through 1997. Certainly, there would be some limited amount of support from a laboratory for an ongoing project. The money continues through 1997, but the development of data to confirm the plant parameters is completed much earlier than that.

Mr. WOLPE. Why are we spending money then if there is no research being done in 1997?

Mr. YOUNG. Because in any kind of a project where you have a technical organization that has the expertise needed to support it in a project and going into construction and licensing, you must pay for certain people to be around to support that.

Mr. WOLPE. In other words, these people are just sitting in the laboratory?

Mr. YOUNG. They are not sitting. They are participating in discussions with the contractors, contributing to designs, contributing to procurement of equipment and so forth, but the actual tests that would establish the parameters are done much earlier than 1997.

No more than one or two years after the demonstration is completed would the full set of individual feature tests be completed.

Mr. WOLPE. Then if that funding as you have described it is unrelated to research development demonstration, would that not be properly categorized in another category of the budget? I mean I am just reusing your own report here.

If you are telling me that they are not doing any research development and demonstration program work when you are spending $25 million on that effort in 1996 and 1997, I have got questions of what they are doing.

Mr. YOUNG. Well, what they are doing is contributing technical expertise to a complicated process of design, licensing, procurement and ultimately construction.

Mr. WOLPE. It has nothing to do with research development and demonstration?

Mr. YOUNG. Perhaps we should identify it with a different name in that time frame.

Mr. WOLPE. Perhaps we should. I must tell you that that is one of the rather remarkable responses I have heard to this kind of question.

Let me ask you, Mr. Bernero, what is the length of time you would expect it would take to build an NRC licensing, to have that decision established, assuming you have the funding and all?

Mr. BERNERO. I am sorry to say we really don't know. We took an estimate that in the space of a relatively few months, we estimated an effort over a several month period. We could come to grips with that and make an assessment of it. There are novel technical issues here. We are not sure how far we would have to go in any one area in order to explore the safety implications.

Mr. WOLPE. So this could take some time.

Mr. BERNERO. We really can't tell you. It could. We have discussed with DOE some of the specialized technology where we have no familiarity. We are certainly familiar with UF6, uranium hexafluoride based plants. We license fuel cycle plants every day that way. But in some of the laser technology, we have had no regulatory experience.

Mr. WOLPE. What is the anticipated time when we would finally have AVLIS on line, actually up and functioning?

Mr. YOUNG. I would say our best current estimate is the end of this decade.

Mr. WOLPE. By the year 2000 or thereabouts?

Mr. YOUNG. Yes.

Mr. WOLPE. Your contract starts to run out in 1994. It will all be expired by the year 2000. So if there is any slippage here, are you not in a situation where all the—it may be essentially too late, that the market will have been taken by alternative sources?

Mr. YOUNG. No, I don't believe so. I indicated before that, for example, in the 1996 to 1998 time frame, where we have opportunity in the market to offer—we believe we have made very competitive offers to our potential customers.

Mr. WOLPE. But in this instance, you are telling me that the contracts run out and it is a very reasonable possibility that many of the contracts will expire in advance of AVLIS coming on line. Is that correct?

Mr. YOUNG. Yes, that is correct. I am telling you it is a declining curve.

Mr. WOLPE. Sure.

Mr. YOUNG. What I am saying is that we are making competitive offers to fill in that decline, offers which we believe will be attractive to customers such that we can tide the enterprise over until such time as AVLIS can be brought on line.

Mr. WOLPE. Based on the promise that it will be an economic venture and will succeed.

Mr. YOUNG. We would have to produce in that time frame, using the existing diffusion plants. We have looked at our marginal cost of production in the diffusion plants and have crafted offers that make the Government money and net revenue that we think are attractive in the marketplace and would tide the corporation over until such time when AVLIS could be brought on board, and we would be able to make even—or the Government corporation would be able to make even more profit.

Mr. WOLPE. How do you anticipate competing with the spot market price of $50 to $55 an SWU?

Mr. YOUNG. We don't try to compete with the spot market price. The spot market prices are for limited amounts of uranium for short-term contracts. We aren't trying to compete in that market. We are competing in the long-term market.

Mr. WOLPE. I must say that given the long-term nature of the contemplated investment here, that we are making an awful lot of decisions at an early point that may not be borne out by economics into the future, is that not the case?

Mr. YOUNG. I think that all of these decisions are judgments. We believe the prospect of the technology for, in a business sense, making money or in a Government sense, bringing revenue, is such that it is most prudent to bring it aboard as early as you can.

The demonstration, we believe, provides sufficient information to make a decision to proceed with deployment. We believe that an investment that would have to be made in the deployment activities prior to getting the final confirmation of data would be very small. It would be such that a private sector investor would be willing in the interest of earlier profits to put an initially at-risk small amount of money until he gets a license from the NRC and then build a plant.

Mr. WOLPE. Thank you very much.

Thank you, Madame Chair.

Mrs. LLOYD. Thank you very much, Mr. Wolpe.

Thank you gentlemen for your testimony. We will be submitting additional questions in writing. I want to commend you on your testimony and your insight and your response.

Our second panel today will lead off with Dr. James Davis of the Lawrence Livermore National Laboratory. It is always a pleasure to see Dr. Davis.

It is also a pleasure to welcome Dr. Robert Merriman from Martin Marietta Energy Systems.

Then we complete our panel with Mr. Eugene Miles. Mr. Miles is Director of Fuel Cycle Materials and Services for the Westinghouse Corporation.

Mr. Miles, we welcome you to our proceedings today.

We are going to ask that you gentlemen summarize your written statements to about ten minutes. That will allow time for sufficient questions.

Dr. Davis, please proceed.

STATEMENT OF DR. JAMES I. DAVIS, ASSOCIATE DIRECTOR FOR LASERS, LAWRENCE LIVERMORE NATIONAL LABORATORY

Dr. DAVIS. Good afternoon to you and the other committee members and the staff.

My name is Jim Davis. I am the Associate Director for Lasers at the Lawrence Livermore National Lab. I greatly appreciate the opportunity to give my testimony today.

Mrs. LLOYD. We are delighted you are here today.

Dr. DAVIS. On behalf of the Laboratory, I would like to express our appreciation for the unwavering support of your committee to this project over the years. We think it has the promise, some of which has been mentioned earlier and I hope to elaborate on in my summary and my statement.

From the very inception of this Uranium AVLIS program, the principal mission has been to provide the U.S. an enrichment technology which produces separative work at lower cost than alternative technologies. Those are today gaseous diffusion and gas centrifuge.

The success of this program will contribute substantially toward our energy security as well as enhance our technical and economic competitiveness relative to foreign enrichment service suppliers. It will allow us to retain an increased U.S. share of the international uranium enrichment services market, which represents potentially tens of billions of dollars of revenue over the next 20 years.

Furthermore, the AVLIS technology has much broader applicability than just uranium enrichment. U.S. industry has shown a growing interest in alternate applications, recently demonstrated through letters of intent to invest corporate funds to evaluate specific applications.

Technical progress has been excellent. The U.S. currently has a three to five year lead in this technology over the strong Japanese and French Uranium AVLIS programs.

It is vital to establish a clear future course of action for this program which leads toward deployment; otherwise, there is a great risk that other countries can deploy Uranium AVLIS ahead of the U.S. We in the U.S. have a history of developing outstanding major technologies and then losing out to other countries who are able to capitalize on development efforts more quickly. We need to make certain that this doesn't happen again, particularly for technology as important as Uranium AVLIS.

Now I would like to look back over past activities in the program. In 1985, the U.S. terminated development of all other advanced technologies to focus resources on AVLIS technology. During the 1987 and 1988 time period, a series of demonstrations were conducted to validate the separative performance of the AVLIS process at large-scale. There was an AVLIS Technical Evaluation and Review group, the so-called TERG that concluded after a lengthy review that the AVLIS process performance predicted for a production plant has been validated to within 25 percent.

Armed with these results, the Department of Energy supported the initiation of a plan to construct integrated plant-scale equipment and proceed with life-cycle testing of this equipment. Though many tests of this equipment are to be conducted, a specific series of integrated equipment tests designated as the "Uranium Demonstration System" is to be completed by late 1992.

Subsequent to this "demonstration", there is planned a continued program of life-cycle testing to improve economic performance and provide necessary detailed design information for plant equipment.

Experience with earlier generations of equipment has shown that a focussed life-cycle testing program leads to continual improvement in equipment reliability, availability and maintainability and therefore, cost reductions when the plant comes into operation. That is the main purpose for a continual life-cycle testing program. It is to assure continual reductions of lower operating costs.

Based on earlier results, the Department of Energy in 1990 provided to the Congress a "Plan for the Demonstration, Transition and Deployment of Uranium AVLIS," which called for, one, demonstration of plant scale hardware; two, industrial participation; three, selection of a commercial deployment contractor; four, execution of an NRC licensing process; five, evaluation of candidate plant sites; six, preparation of environmental impact studies; seven, beginning the engineering-only line-item for plant design; and eight, the establishment of a Government Enrichment Corporation and/or a private corporation to deploy AVLIS.

In the Administration's fiscal year 1992 budget, the proposal is to continue only the technology demonstration activities and to pursue formation of a Government Enrichment Corporation, delaying all other activities.

I strongly support prompt establishment of a Government Enrichment Corporation and continuing the technology demonstration activities. However, delaying the other activities will result in irretrievable loss of the current U.S. lead in AVLIS technology.

Additionally, it is not practical to complete all major technology demonstration activities without obtaining relevant information from potential industrial participants and regulators, so that their concerns can be factored into equipment, systems and plant designs and operating procedures.

In the interest of controlling costs and maintaining the U.S. lead, selected tasks should proceed in order to protect options for deployment without major disruptions of program activities.

Furthermore, we talked earlier about technology. Technology development doesn't stand still. The major technical features of the Uranium AVLIS equipment being demonstrated in fiscal year 1991 and 1992 were selected in previous years. If this equipment is not to be deployed in the near future, it will be necessary for the program to revert back to a program of equipment innovation in order to maintain a U.S. lead in technology. Witness the micro chip industry or any other technological industry. It doesn't stand still.

With regard to a course of action for deployment, there are three principal strategic options for Uranium AVLIS. Namely, number one, the Government Enrichment Corporation; number two, a Department of Energy Enrichment Program; or number three, a Private Sector Cooperative R&D and Tech Transfer Venture. All of these options should be protected pending Congressional actions concerning the proposed Government Enrichment Corporation.

Some well-qualified firms have already expressed interest in initiating Cooperative Research and Development Agreements, so-called CRADAs, with the Laboratory under the National Competitiveness and Technology Transfer Act of 1989 for the purpose of transferring to the private sector the Federally developed and controlled AVLIS technology.

This approach potentially provides the most expeditious means for firmly identifying the arrangement and developing the proposals under which qualified private sector firms would be willing to undertake cost shared deployment of Uranium AVLIS.

During fiscal years 1991 and 1992, those activities should be conducted which are needed to protect the deployment options I have discussed and which would avoid program disruptions and unnecessary delays and deployment.

Specifically, one, legislation to establish a Government Enrichment Corporation should be sought; two, currently planned equipment and systems development, demonstration of life-cycle testing should continue as proposed in the Administration's budget request; three, the Department of Energy should grant authority to the University of California to create Cooperative Research and Development Agreements for AVLIS technology between the university and private sector corporations; four, preparation for an NRC licensing should proceed, including development of engineering designs; and five, environmental impact studies and site selection studies should proceed.

Finally, the original program plan called for an additional $61 million more than the Administration's fiscal year 1992 budget.

While the full amount may be difficult with the tight budget situation, I do not believe it is either prudent or cost effective to provide zero funding for these activities. Additional funding of $20 million to $25 million above the Administration's request in fiscal year 1992 is needed to support these activities in order to help to provide assurance that the U.S. will benefit from its investment and Uranium AVLIS technology through maintaining the nation's current competitive advantage.

AVLIS is the only enrichment technology the U.S. currently has under development. Failure to deploy this technology in a timely way will in the future reduce the U.S. to the position of importing foreign technology which will guarantee that it will be at best and second place, or even worse, of importing foreign nuclear fuel which will represent a failure of U.S. leadership.

Speaking personally, Madame Chairman, I give a lecture to the team at Livermore annually now of the importance of getting the technology into a deployment contractor's hands. We are committed to put people on leave of absence, whatever it takes to accomplish this with whatever firm is selected to deploy the technology. We are anxious to move forward. I thank you very much.

[The prepared statement of Dr. Davis follows:]

L-12954

Uranium AVLIS Program

Statement prepared for
Subcommittee on
Energy Research and Development
House Committee on Science, Space and Technology

by

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Summary of the
Uranium Atomic Vapor Laser Isotope Separation Program

Background - The U.S. Department of Energy's (DOE) uranium enrichment enterprise is a vital link in the fuel supply chain for nuclear power plants. Enrichment sales to overseas customers currently contribute approximately $500 million yearly to the U.S. trade balance; sales to U.S. utilities provide a secure domestic source of nuclear energy. With the expected expansion of nuclear power in the next century, the potential contributions to balance of trade could become several billions of dollars when we implement the low-cost technology offered by laser isotope separation, a technology pioneered in the U.S. in which we currently have a national competitive advantage.

The U.S. role in this international enrichment market has important effects on this country's energy security, technological and business competitiveness, balance of trade, safeguards and non-proliferation policy, supply of special nuclear materials, and employment. Until 1974, the United States was the sole supplier of enrichment services to the free world. Since then, foreign enrichment capacity and market share have grown significantly in an expanding market. By the late 1980's U.S. market share had been reduced to approximately 50%. The international enrichment market is expected to remain intense for many years to come.

Laser Isotope Separation - To reverse the erosion of enrichment market share and reduce the vulnerability to foreign competition, the DOE has developed a lower-cost enrichment technology, the Uranium Atomic Vapor Laser Isotope Separation (U-AVLIS) process has been under development by the Lawrence Livermore National Laboratory jointly with Martin Marietta Energy Systems for the past 15 years. This process is believed to be the lowest cost enrichment technology known. As part of the deployment plan for this technology other industrial companies will be able to bid on plant construction, ownership, and operation.

Concept - The U-AVLIS technology consists of three major subsystems: lasers, separators, and uranium chemical processing for the interface with the nuclear fuel cycle. Lasers selectively charge the 235U isotope in the separator where it is collected as enriched product. After removal from the separator the product is chemically processed into a form acceptable for fuel for nuclear reactors.

A key reason for its low cost is due to the electric energy conservation that is possible with U-AVLIS technology. Replacing existing enrichment plants would conserve the output of two 1GW electric power plants. Another characteristic of AVLIS technology is its potential for improving public environmental, safety and health impacts. AVLIS production plants interface with the fuel cycle using uranium oxide which is less hazardous, produces significantly less nuclear low-level waste, and is less expensive than using the existing uranium hexafluoride interface.

Technology status - Plant-scale, laser and separator hardware have been operated at the Livermore site since 1987, and recent enrichment demonstrations have verified key performance predictions. More than 1.5 million unit hours of operation have been accumulated on the copper lasers. This is the highest average-power, visible laser system operating in the world today. The current DOE plan submitted to Congress calls for enrichment performance demonstrations in 1991 and 1992 with plant-scale hardware to place the technology in position to begin plant construction as rapidly as possible.

Funding - Resources for the development of this technology come from DOE's enrichment sales to U.S. and foreign utilities, not from general tax funds. Funding prior to 1991 to develop this technology totals $974 M; FY 1991 funding is $154 M. The capital cost to construct an U-AVLIS plant with sufficient capacity to significantly improve the U.S. competitive position in the international market place is approximately $1000 M.

Alternative Applications - The National Academy of Science is conducting a study of other potential applications of AVLIS technology. These include generating fuel for our nuclear Navy, reducing nuclear radioactive waste through re-enrichment and refined chemical processing, isotopic tailoring of burnable neutron absorbers, improving safety in the enrichment industry, and processing and purifying industrial materials.

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Uranium Atomic Vapor Laser Isotope Separation Program

Dr. James I. Davis, Associate Director for Lasers

Lawrence Livermore National Laboratory

I would like to express my appreciation to this Committee for the opportunity to present a statement on the Uranium Atomic Vapor Laser Isotope Separation (U-AVLIS) Program and its role in the future of the United States Uranium Enrichment Enterprise.

Development activities in the U-AVLIS Program at Lawrence Livermore National Laboratory (LLNL) began in 1973. Since 1976 there has been a fruitful and cooperative effort between LLNL and originally, Union Carbide Corporation and now, Martin Marietta Energy Systems (MMES) at Oak Ridge. The progress and recommendations that I report here today and the plans that I will present result from the joint efforts of our two organizations, together with those of the Department of Energy.

Introduction

The U-AVLIS Program is aimed at enriching natural uranium to fuel commercial power reactors. The overall objectives of the program are to develop, demonstrate, and document a uranium enrichment process capable of maintaining a competitive U.S. uranium enrichment enterprise in the long-term and to deploy U-AVLIS including an efficient transfer of this technology to qualified industrial organizations by training, participation, and documentation (**Figure 1**). The highly competitive, international market for uranium enrichment provides the motivation for U-AVLIS development and deployment, since it is believed to be the lowest cost uranium enrichment technology known.

The U.S. role in the international enrichment market has historically been important to this country for reasons of energy security, national security, technological leadership, economic competitiveness, balance of trade, safeguards and nonproliferation leadership, and U.S. employment. Uranium AVLIS deployment can help the U.S. continue to achieve its policy objectives in these areas (**Figure 2**).

Evolving market, economic, and technological forces all point to the need for a new low-cost U.S. enrichment capability as rapidly as possible (**Figure 3**). An assessment of foreign competition, enrichment market demand, and the capabilities of U.S. gaseous diffusion plants shows that the U.S. Enrichment Enterprise could possibly become less competitive in the time frame beyond the mid 1990s.

Our foreign competitors have significantly eroded the U.S. share of the free-world enrichment market; they continue to seek an additional share with aggressive marketing, increased capacity, competitive pricing, and technology improvements. Although the United States currently has an approximate three-to-five year lead in the development of the AVLIS technology, the U.S. is by no means the only country with a sizeable AVLIS program. Recognizing the potential cost advantages and other benefits of AVLIS, both the French and the Japanese have aggressive AVLIS technology development programs underway. It appears probable that whether or not the U.S. deploys U-AVLIS, some other country will. Both France and Japan possess the technical capability and the national resources for successful AVLIS deployment. The U.S. must move aggressively to protect its present lead in this technology.

Fortunately, the technological status of the national U-AVLIS Program is well positioned to face the competition and meet the needs of the marketplace. During FY87 and FY88, the integrated laser and separator technologies have been demonstrated at large-scale and have provided a sound basis for predicting U-AVLIS enrichment performance. Results from these demonstrations serve as the basis for the current U-AVLIS plant design. Factory DOE production cost for a nominal 10 million separative work unit (SWU) per year capacity is projected at approximately $25 per SWU. For private deployment of U-AVLIS, a market sales price of approximately $60 per SWU would provide a 20% return on investment after taxes and after all expenses including an assumed 10% royalty on sales to recover Government investment in U-AVLIS. Smaller expandable plant deployment is also practical but at somewhat higher initial SWU cost.

The laser, separator, and uranium processing technologies are now sufficiently engineered that the first steps toward plant deployment can be taken with high confidence. These steps are the demonstration of plant-scale system operations at LLNL and MMES, and the initiation of key long-lead predeployment activities including the engineering design of the plant.

A plan designed to achieve these near-term objectives was jointly developed by DOE and the U-AVLIS Program and was submitted to Congress by Secretary Watkins early in 1990. The cornerstone of this plan is a major decision to be made in November, 1992 by the Secretary on whether to continue to deploy U-AVLIS according to this plan. Key activities to be accomplished include:

- Completion of plant-scale hardware engineering for demonstrations to support the decision to deploy.

- Expansion of the already significant industrial participation in the U-AVLIS Program by selecting a commercial deployment contractor, utilizing additional independent review groups, and enhancing existing industrial access.
- Completion of predeployment activities including site selection, engineering design, NRC licensing, and environmental documentation.

Implementation of this plan by the Congress, DOE, and the U-AVLIS Program would strengthen the United States' position in the highly competitive international enrichment market and help to preserve our energy security.

Technology Status

It is because of the very significant progress that has been made over the past several years that it is now possible to consider details for U-AVLIS deployment strategy. Planning for plant deployment is based on the assumption that plant construction will be triggered by demonstration of hardware performance and enrichment operations at a high level of system integration. Many of the elements of these systems have been fully demonstrated at levels required for plant use. Integrated enrichment demonstrations have provided a sound basis for predicting U-AVLIS performance. Those elements that have not yet been fully demonstrated have achieved performance levels adequate to give high confidence that the challenges of the next steps toward plant deployment can be successfully met. Key program accomplishments in FY90 that lead to plant deployment include:

- Completing greater than 1.5 million copper laser unit hours of operation with the world's highest average power visible laser system.
- Completing detailed separator pod engineering refinements and beginning plant-scale pod operations that have resulted in a simpler design, more resilient operating plan, and lower overall contribution to enrichment cost.
- Demonstrating uranium chemical processing technologies that provide the potential for additional fuel cost reductions to the utilities.
- Developing a joint DOE and U-AVLIS Program plan to complete full-scale hardware demonstrations, initiate predeployment activities, expand industrial participation, and place the U-AVLIS technology in position to deploy a production facility as rapidly as possible.

These accomplishments represent significant progress and are detailed below (**Figures 4 and 5**).

Lasers. Greater than 1.5 million cumulative hours were surpassed with the copper laser system during operations on an around-the-clock-basis for the past six years. Recently, the system output has reached power levels over 8760 W, which meets a major program milestone. To date, the plant copper laser chain has achieved over 1400 W of power in initial advanced chain tests. The dye laser system operates on demand; single dye chain powers in excess of 1250 W for over 130 continuous hours have been achieved. Over 2200 W of optical power has been demonstrated from the laser system with multi-wavelength process light for long duration (~150 hours).

Separators. Separator pods are now operating at plant-scale to support the Uranium Demonstration System (UDS) operations in 1991 and 1992. To date in specimen tests, the collector components have been successfully tested for a separator environment with corrosive liquid uranium metal for times exceeding 100% of plant life. Enclosure materials have reached over 50% of plant life in specimen tests. Uranium vapor rates and densities have also achieved plant values in preliminary tests of a prototypic vapor source. Separator Demonstration Facility modifications are also nearing completion to support UDS operations.

Uranium Processing. Based upon bench-scale feed conversion tests that demonstrated technical feasibility, an advanced metal-based process has been selected for further demonstrations. For product conversion, demonstrations to date have purified U-AVLIS product to levels exceeding nuclear fuel specifications in kilogram lots and uranium oxide product has been produced in 150 kg lots by the plant baseline process for preliminary evaluation by the fuel fabrication industry. Progress has also been made toward completion of the product conversion demonstration facility at Oak Ridge, and discussions with industry on U-AVLIS fuel cycle interfaces are continuing.

Integrated Enrichment. Multiple enrichment demonstrations over the past several years have verified the integrated performance of U-AVLIS technology. This past year, a series of Special Isotope Separation integrated tests of plant-prototypic hardware were successfully completed. Tests lasted over 100 hours and used several surrogate (non-plutonium) materials. Prior runs in 1987 and 1988 demonstrated integrated uranium enrichment and validated process performance to within 25%.

Uranium AVLIS Deployment. A joint DOE and U-AVLIS Program Plan has been established to complete full-scale hardware demonstrations, initiate predeployment activities, and expand industrial participation. These activities support a key decision in November, 1992 on whether to continue U-AVLIS deployment according to this plan, and they place the Program in position to begin plant construction to initiate production as rapidly as practicable. This plan is based upon plant point design efforts completed in FY89 and serves as the basis for plant site selection activities that have been initiated as part of the predeployment activities.

Uranium AVLIS Plant Design

There are several inherent features which make the U-AVLIS process an attractive, low-cost enrichment technology (**Figure 6**). These features are the modularity of the equipment design and the high performance of the special U-AVLIS systems. With regard to the modularity, the plant is built up of sets of many identical components that are engineered to operate as parallel distributed subsystems. For example, this allows smaller initial enrichment capacity to reduce capital at risk and capacity expansion to be built in phases as the market opportunities develop. The parallel operation of modular subsystems results in high plant availability and allows operators to remove and replace degraded components while the system is still operating. Most important, the risk of building an entire plant will be very small, since the performance and economics of modular units can be validated in the near term with a relatively small fraction of the full plant hardware. In addition to this modularity, U-AVLIS enrichment is achieved with hardware which has very high throughput and performance per pound of equipment and per unit area of process buildings and which results in low capital and enrichment cost.

Deployment Planning

The U-AVLIS Program focus is expanding from engineering and demonstrating plant-scale hardware, to initiating the transition to deployment and to deployment activities (**Figure 7**). As a result of the need for U-AVLIS, a deployment plan has been jointly established by DOE and the U-AVLIS Program and submitted to Congress by Secretary Watkins that could successfully complete the demonstration program and take the program through deployment (**Figure 8**). This plan needs to be updated, but it identifies the key elements required to direct program efforts from an industrial, entrepreneurial, and profit-oriented perspective.

The plan takes full advantage of recent significant technical progress in lasers, separators, and uranium processing, coupled with a concurrent demonstration and deployment approach. This combination offers the opportunity to keep overall U-AVLIS program costs down, while also lowering program risks by closely coupling the technology demonstration and technical support program to plant deployment activities. The Uranium Demonstration System (UDS) at LLNL and MMES will provide the key economic and technical data for the decision to start plant construction. Critical-path predeployment activities, including the completion of the Conceptual Design Report (CDR), compliance assessments (environmental, health, and safety), site selection, and proposed NRC licensing activities, need to proceed in parallel with the demonstration phase of the program to achieve optimum program benefit. Cornerstones of this plan are to increase the already significant industrial involvement in U-AVLIS, to expand the scope of independent reviews to address deployment issues, and to select the Commercial Deployment Contractor for the U-AVLIS Program.

DOE has strongly supported U-AVLIS development and preparation for deployment. The proposed strategy is to establish a Government Corporation which would take over the complete U.S. enrichment enterprise and would make future decisions concerning U-AVLIS deployment. Private sector investment in U-AVLIS deployment has been encouraged. Although this continues to be DOE's preferred strategy, Congress has not yet provided the necessary legislation. With the delay in legislation to establish the Government Corporation, the Administration now proposes to modify its plan and to continue only with the technology development and demonstration activities, delaying all pre-deployment activities. However, delaying all pre-deployment activities could result in irretrievable loss of the current U.S. lead in U-AVLIS. An assessment of the alternative organizational options for U-AVLIS deployment shows several selected actions that can be taken to protect the U.S. lead, without major disruptions of program activities.

Before outlining these actions, it is helpful to assess the possible organizational structures for U-AVLIS plant deployment; these are deployment by: 1) DOE, 2) the Government Corporation, or 3) a private sector-government cooperative venture.

For DOE deployment, all funding including RD&D is provided by DOE through Congressional appropriations, and plant revenues are dispersed at the discretion of the Administration and Congress. NRC licensing is also possible under the DOE deployment option with appropriate legislation. It may be required by Congress as a condition for authorizing and funding the U-AVLIS plant, as Congress has done for other projects such as the High Level Waste Repository.

For U-AVLIS deployment by the Government Corporation, DOE's preferred strategy, all funding is provided by the corporation as established by Congressional legislation. The Government Corporation or its private successor would set prices, recover costs, and make profits as would a normal business. NRC licensing will likely be required by the Congressional legislation. The terms and conditions for sale of the Government Corporation to private industry would undoubtedly involve a return on the government investment and licensing rights to use AVLIS technology.

For U-AVLIS deployment by a private sector-government cooperative venture, industrial participation can be implemented through the 1989 National Competitiveness Technology Transfer Act. Non-exclusive licensing of AVLIS technology through this legislation, allows the private sector to participate in U-AVLIS deployment through Cooperative Research and Development Agreements (CRADAs) with LLNL, MMES, and DOE. Under this option, RD&D funding is assumed to be continued by the Government, with arrangements for significant private sector investment to be determined by proposals for U-AVLIS deployment; such proposals would also address the return on the Government's investment in AVLIS. Since this is a totally private deployment option, NRC licensing will be required.

Pending Congressional legislation to establish a Government Corporation, there are selected actions that should be taken to minimize delays in U-AVLIS deployment to protect the U.S. lead in this enrichment technology (**Figure 9**). These actions will be needed in preparation for U-AVLIS deployment regardless of whether the decisions are made by DOE, the Government Corporation, or by a private sector-government cooperative venture. In addition, these actions do not preempt establishment of any of the discussed organizational structures for U-AVLIS deployment. Actions which should proceed include three key steps:

- Continuation of the U-AVLIS technology demonstration program to achieve continual improvements in hardware performance.
- Continuation of preparations for licensing U-AVLIS on a priority basis since the licensing process is expected to be a critical path item controlling the deployment schedule. Obtain any necessary legislation required to permit the Nuclear Regulatory Commission to proceed with U-AVLIS licensing activities pending establishment of the Government Corporation.
- Selection of at least two teams of private sector firms possessing the major qualifications necessary for deployment of U-AVLIS. Provide these teams access to all available U-AVLIS information relevant to deployment and require LLNL to expedite this process. Require each team to provide to the Government, within 12-18 months from start of work, a proposal for U-AVLIS deployment. Require each proposal to delineate the arrangements necessary for the team to provide significant private sector investment in U-AVLIS deployment. DOE should, through LLNL and the U-AVLIS Program, implement non-exclusive licensing for U-AVLIS technology to the private sector to enable the immediate establishment of these industrial participation teams.

The early involvement of at least two industrial participation teams in the U-AVLIS Program is of particular importance for preserving the schedule. The Program recommends selection of these teams by the end of FY91 so that their expertise and perspective can be effectively integrated into the Program throughout FY92. This process would aid in preparing private-sector organizations for potential selection as the Commercial Deployment Contractor by DOE after the Government Enrichment Corporation is established, or for selection as a private-sector partner in a cooperative deployment venture with the government.

Many industrial firms have already expressed strong interest in accessing U-AVLIS technology (**Figure 10**). Two major energy and construction firms have expressed interest in obtaining a non-exclusive license for uranium enrichment using AVLIS technology. In addition, nine companies are interested in copper lasers and power supplies for alternate applications to improve their productivity and competitiveness. The early selection of industrial participation teams allowed by non-exclusive licensing of AVLIS technology, benefits the Program and DOE in several ways including:

- Early industrial involvement
- Industrial participation in the demonstration program
- Exchange of knowledge, company culture, perspectives, and expertise between the Program and the private-sector
- Preparation of the private-sector for U-AVLIS deployment

This initial industrial participation can be implemented through LLNL's Technology Transfer Program by using Cooperative Research and Development Agreements (CRADAs).

By taking the actions recommended, U-AVLIS predeployment activities can proceed in parallel with the establishment of the Government Enrichment Corporation and potential delays in the plant deployment schedule can be minimized (**Figure 11**). Since the NRC regulations for licensing enrichment plants under 10CFR40/70 rules are not yet defined by the NRC, the established regulations under part 10CFR50 are used to define the regulatory process for the U-AVLIS deployment schedule in this figure.

The Program's request for the FY92 budget was $275 million or $61 million more than the President's budget (**Figure 12**). The additional resources would move the Program along on the best achievable schedule and include the Program's recommendation for a $27 million engineering only line item in order to proceed with critical-path predeployment activities while DOE and the Congress establish the Government Enrichment Corporation. Resources are also included to bring operating funds to levels defined last year to complete the full scope of demonstration activities and to compensate for the impact of continuing compliance with evolving ES&H directives from DOE. This request is consistent with the urgent need for U-AVLIS deployment.

Conclusions

Near term deployment of an U-AVLIS enrichment plant in the United States is an important objective for the Enrichment Enterprise because of current commercial market, economic, and technological forces (**Figure 13**).

An assessment of foreign competition, enrichment market demand, and the capabilities of U.S. gaseous diffusion plants shows that the U.S. enrichment capability can potentially become increasingly noncompetitive in the time frame beyond the mid 1990s. A continuing strong commitment to complete U-AVLIS demonstrations and predeployment activities that lead to plant construction is needed.

Successful implementation of an U-AVLIS enrichment capability by the U.S. can help to achieve strategic goals in many significant areas including:

- Energy security
- National security
- Energy conservation
- Balance of trade
- Nonproliferation policy
- Employment
- Environment, safety, and health
- Technology leadership
- International economic competitiveness.

The necessary steps to establish a low-cost U-AVLIS enrichment plant in the U.S. by the mid- to late-1990s are outlined in DOE's Plan for the Demonstration, Transition, and Deployment of U-AVLIS Technology which was submitted to the Congress in January of 1990. Pending establishment of the Government Corporation by Congress, several key actions by Congress and DOE are needed to retain the U.S. lead in U-AVLIS and to protect deployment options without major program disruptions. These actions are: 1) to continue development and demonstration activities, 2) to establish NRC licensing for U-AVLIS deployment and continue preparations for licensing, and 3) to implement non-exclusive licensing for U-AVLIS technology to the private sector to enable the immediate establishment of industrial participation teams for deployment.

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Uranium AVLIS Program objectives

- To develop, demonstrate, and document a uranium enrichment process capable of maintaining a competitive U.S. uranium enrichment enterprise in the long term
- To deploy U-AVLIS including an efficient transfer of this technology to a qualified industrial organization by training, participation, and documentation

1 0 2590 1561

Figure 1

AVLIS deployment can help to achieve important U.S. policy goals

- Energy security
- National security
- Energy conservation
- Balance of trade strength
- International safeguards and nonproliferation leadership
- Employment growth
- Technology leadership
- International economic competitiveness

Figure 2

[illegible]

The role of U-AVLIS in the U.S. Enrichment Enterprise

Today, more than ever, U-AVLIS technology provides the basis for a continuing, strong, U.S. uranium enrichment capability

- The international market remains highly competitive
  - Demand growth is slow; supply significantly exceeds demand
- European and Soviet enrichers are expanding supply and continue to market aggressively
  - To our foreign customer base
  - And, at an increasing level, to our domestic utilities
- Concerns continue to exist regarding the future competitiveness of our gaseous diffusion plants
  - Escalation of both power and non-power costs

Completion of U-AVLIS demonstrations, predeployment activities, transition to expanding industrial participation and deployment will strengthen the United States' position in the international enrichment market and help preserve our energy security.

1.2.0290.0415

Figure 3

03/15/91

FY90 progress in AVLIS technology continues to meet Program objectives

- Lasers: significant improvements in power level, life, design simplicity, and cost reduction
  - Copper laser system operates around the clock and is highest average power visible laser in the world—over 8,700 W
  - Plant-scale copper laser chain initial operation near plant power
  - Dye lasers operate at demonstration goals of over 1/2 plant power

- Separators: current design for plant-scale separator pods now operating in test facility
  - Plant vapor rate and density demonstrated
  - Separator Demonstration Facility modifications for enrichment demonstrations near completion

- Chemical processing: technology appropriate for metal-based AVLIS process identified and improvements being developed
  - Near-term fuel cycle interfaces use existing industry equipment
  - Long-term advanced technology provides improved safety, reduced waste, and lower cost
  - Discussions with feed conversion and fuel fabrication industry continue

Figure 4

1.2.0990.1512C

3/8/91

FY90 progress in AVLIS technology continues to meet program objectives (cont.)

- Integrated enrichment: Multiple runs verified enrichment performance
  - Completed recent series of integrated tests for Special Isotope Separation
    - Multiple separators in series
    - Surrogate materials utilized
    - Tests lasted >100 h
  - Prior enrichment runs demonstrated process physics for uranium

- U-AVLIS deployment: Activities required for deployment started
  - Completed a plan with DOE for the demonstration, transition and deployment of U-AVLIS technology
  - Began plant site selection and commercial deployment contractor selection activities
  - Initiated contacts with NRC for possible licensing
  - Began work on required ES&H assessments
  - Initiated plant conceptual design activities

Figure 5

Inherent features of AVLIS technology make a low-cost enrichment plant possible

- With high performance, modular equipment and high uranium throughput
  - The capital contribution to U.S. AVLIS enrichment cost can be particularly low
  - With such a low capital cost technology, the plant can be designed to operate with relatively short-lived hardware components and still maintain low overall enrichment cost

- Hardware designs and component lifetimes necessary for a low-cost AVLIS production facility can be achieved and demonstrated in the relatively near-term
- Decisions leading toward commercial deployment can be made with a sound technology, engineering, and operations database

Figure 6

The focus of the U-AVLIS Program has shifted toward plant deployment

- Major AVLIS systems now under construction and test for the Uranium Demonstration System (UDS) are versions of plant hardware
  - High power copper laser chain has plant-scale laser, power supplies and optics
  - High power dye chain has plant configuration with fiber optic transport of copper pump light
  - UDS separator module has plant architecture, optics, and separator pods
  - Near-term feed and product interfaces accommodate existing fuel cycle industry
- Establishment of industrial participation teams has to become a major program effort

The UDS demonstration will provide the key economic and performance basis for the decision to start plant construction

Figure 7

0 1299 3392G

3/8/91

Key elements of DOE plan for AVLIS, submitted to the Congress by the Secretary, need to be completed

- All key elements of the plan are clearly necessary if AVLIS deployment is to be achieved
  - Demonstration of plant-scale AVLIS hardware
  - Completion of predeployment activities for engineering design, site selection, NRC licensing and NEPA documentation
  - Expansion of the level of private-sector involvement
- Prompt establishment of the Government Enrichment Corporation would benefit AVLIS deployment

1.0.0391.0310

Figure 8

Recommended actions to best prepare AVLIS for timely deployment

Government actions	Results
• Continue development and demonstration program activities	• Provides economic and technical basis for a deployment decision and continual performance improvements
• Support early legislation and resources for NRC licensing of AVLIS and continue license preparation activities	• Removes regulatory uncertainty and accomplishes critical path activities as quickly as possible prior to establishment of the Corporation
• Allow non-exclusive licensing of AVLIS technology to private sector	• Enables immediate establishment of industrial participation teams for selection as the Commercial Deployment Contractor or the private partner in a cooperative venture with the government

1.0391.0305

Figure 9

Many major private sector companies are currently interested in accessing AVLIS technologies

- Two major companies in the energy and construction sectors have expressed interest in obtaining non-exclusive licenses for uranium enrichment
- Six moderate to small size companies are interested in AVLIS power supply technology
  - The potential uses are at the component and major system levels
- Three companies are interested in pursuing laser materials processing programs for application in their existing product lines using copper vapor lasers
  - These are leading companies in the chemical, aerospace and semiconductor equipment industries

Licensing AVLIS technology allows these companies to participate in the program through the LLNL technology transfer process utilizing Cooperative Research and Development Agreements (CRADAs)

1.0.0391.0309

Figure 10

AVLIS recommended schedule for early deployment that accounts for the establishment of the Government Enrichment Corporation

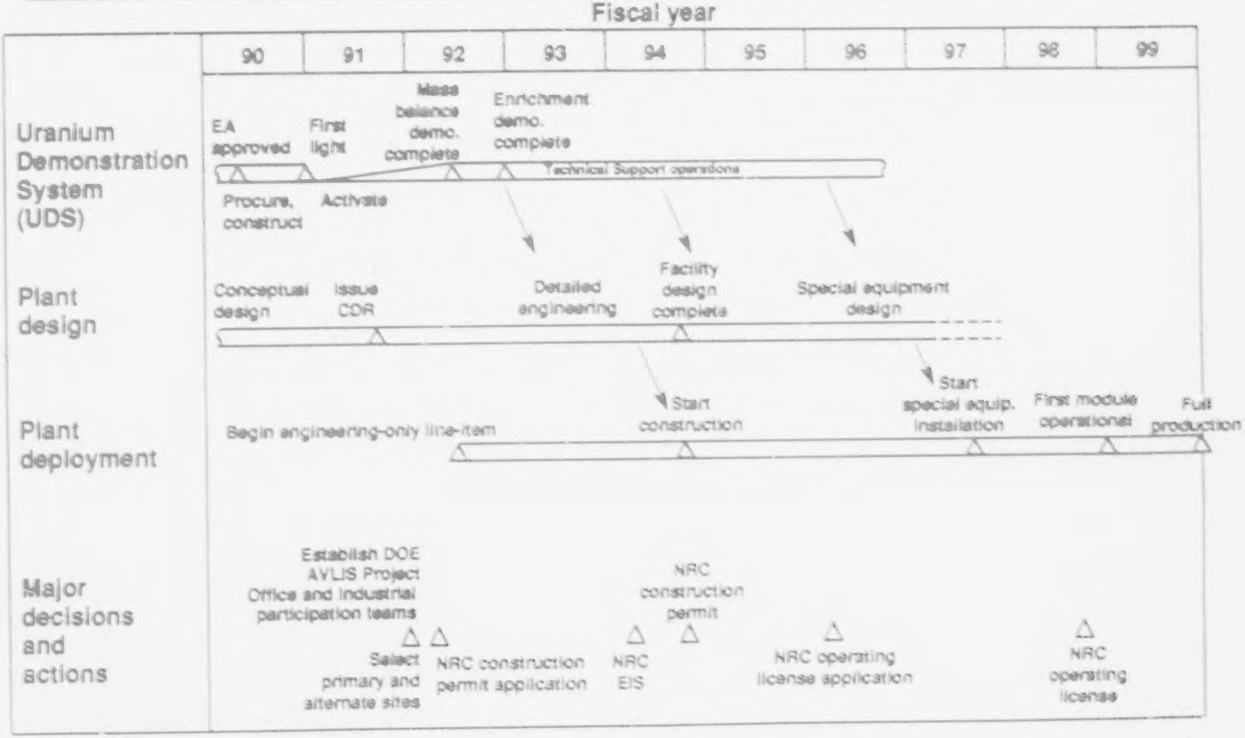

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Figure 11

03/08/91

DOE and U-AVLIS Program budget requests

Budget reference	Funding level ($M)*		
	FY91	FY92	FY93
President's Budget and DOE Planning Guidance	155	214	Not yet established
U-AVLIS Program request allowing prompt deployment	155	275	347

*As-spent dollars

The U-AVLIS Program request for FY92 includes $27 M for an engineering-only line-item to proceed with critical-path predeployment activities during the establishment of the Government Corporation or private-sector partners

Figure 12

U-AVLIS Program—concluding comments

- U-AVLIS is needed by the U.S. because:
  - Energy security, international economic competitiveness, and balance of trade require the U.S. to reverse erosion of market share
  - Foreign competitive pressure is increasing on uranium enrichment
  - AVLIS enrichment is less vulnerable to Soviet and European low-price market strategies

- The U-AVLIS Program plan is structured to:
  - Complete the demonstration program to support the November 1992 decision
  - Reduce plant risk by continued operations of demonstration equipment in FY93
  - Establish industrial participation teams in the Program in FY91 to define in FY92, arrangements necessary for private sector investment in AVLIS deployment
  - Allow sufficient time to establish the Government Enrichment Corporation or private-sector partners which then permits plant construction in mid-FY94 and initial production in 1998

Figure 13

Mrs. LLOYD. Thank you, Dr. Davis.

Dr. Merriman, please proceed.

STATEMENT OF DR. ROBERT MERRIMAN, VICE PRESIDENT, APPLIED TECHNOLOGY, MARTIN MARIETTA ENERGY SYSTEMS, INC.

Dr. MERRIMAN. Madame Chairman, I would like to ask that my full statement be included in the hearing record.

Mrs. LLOYD. Without objection.

Dr. MERRIMAN. I will just proceed to summarize my remarks.

Mrs. LLOYD. Very good.

Dr. MERRIMAN. In your letter of invitation to appear today, you asked that we cover various aspects of the fuel cycle integration of AVLIS. I have dealt with those at some length in my written statement, so what I would like to do in the next few minutes is zero in on a very important question we are really discussing this afternoon, namely deployment of AVLIS.

Madame Chairman, any chance that the United States has to remain competitive in the world enrichment market is tied to the successful deployment of AVLIS. I really regret that we are not here today testifying to you on the progress we have made in the last two years to deploy AVLIS. In some senses, I believe both Dr. Davis and I will sound a little bit like broken records today.

Two years ago we testified that we were ready to move forward in this important project for reasons that you have heard already. Since then, Martin Marietta and its industry team positioned themselves to respond to the DOE/RFP which was announced in the Commerce Business Daily last year and formulated a strategy for effectively transitioning and deploying AVLIS technology. This was planned to be done continuing the close cooperation with Livermore that has been established over many, many years.

As you have pointed out, the DOE fiscal year 1992 budget contains no funding for deployment activities. The RFP announcement has been placed on hold. DOE's budget plan indicates its intention to tie AVLIS deployment to the formation of a Government corporation.

We believe that postponing AVLIS deployment until after the formation of a Government corporation is an unnecessary delay, which poses a serious risk to the AVLIS program and thus to the entire enrichment program as well.

In the 1970s, indecisiveness regarding the privatization of Uranium enrichment in the United States left many of our customers without an assured supply of enrichment services and created an opening for our European competitors to build enrichment facilities and acquire a substantial share of our market.

Our concern today is that once again debate over how to organize the business will delay critical decisions. We are ready to move forward with deployment activities and we do not believe that they should be postponed until the fate of the proposed legislation has been resolved.

Our recommendation is to pursue very strongly the deployment of AVLIS in parallel with equally strong efforts to establish the Government corporation. This action will keep the AVLIS demonstration program focussed on a deployment objective, provide for rapid deployment by the new corporation, maintain our lead over foreign AVLIS competitors and demonstrate to the customers our commitment to providing lower cost for enrichment services.

If we fail to show the utility customers that we have the resolve to deploy AVLIS, we believe this will compromise both the technology leadership that we have as well as our energy security.

Our continued international economic competitiveness, I might add, in this area is also critical for thousands of jobs for American workers. Moreover, we are increasingly vulnerable to the possibility that the U.S. will have to rely on foreign suppliers or foreign technology to obtain uranium enrichment for fueling its commercial power plants.

We must act now, I think, to avoid this threat to our energy security and the threat to the recovery of the substantial investment that the U.S. taxpayers have made in uranium enrichment technology.

Madame Chairman, Martin Marietta recommends that DOE proceed immediately with the competitive selection of a commercial deployment contractor for AVLIS as per the DOE's 1990 plan and get under way those other activities associated with an aggressive AVLIS deployment effort.

We recommend that these deployment activities take place in parallel with efforts to establish an enrichment corporation. We strongly commend your leadership on this important legislation and deeply appreciate your strong support of AVLIS. We stand ready to assist you in any way we can to achieve these goals.

Thank you very much.

[The prepared statement of Dr. Merriman follows:]

RECOMMENDATIONS FOR THE URANIUM ATOMIC VAPOR LASER ISOTOPE SEPARATION PROGRAM

Statement prepared for the Subcommittee on Energy
of the Committee on Science, Space, and Technology
United States House of Representatives
April 10, 1991

Robert Merriman
Vice President, Applied Technology
Martin Marietta Energy Systems, Inc.
Oak Ridge, Tennessee 37831-7133

I would like to thank the committee for inviting me to present Martin Marietta Corporation's recommendations for a program of national importance—uranium enrichment by atomic vapor laser isotope separation (AVLIS).

Uranium enrichment is an essential step in providing fuel for commercial nuclear power plants. These plants supply 20 percent of our nation's electricity and even larger fractions in many other countries. The United States has been the dominant supplier of uranium enrichment services since the earliest days of nuclear power. U.S. enrichment sales amounted to 1.3 billion dollars last year, contributing over $500 million to the net balance of trade. A U.S. role in the international enrichment market is important for energy security, technology leadership, international economic competitiveness, national security and influence in international nuclear policy matters. Our enrichment program also provides excellent jobs for thousands of American workers.

Two years ago, Dr. J. I. Davis of Lawrence Livermore National Laboratory (LLNL) and I testified to this committee that the AVLIS program was at an important crossroads and was ready to move aggressively towards deployment. The circumstances motivating our joint recommendation were: (1) the excellent technical progress made by the LLNL/Martin Marietta Energy Systems, Inc. (Energy Systems) team; (2) the encouraging economic projections for AVLIS; (3) a domestic enrichment capability faced with increasing costs over the long term; and (4) the probable loss of market share due to competition from European enrichers.

Since that time, competition has significantly increased, and the U.S. uranium enrichment enterprise has seen a loss of market share. The Russians have been successful in obtaining their first contract with a U.S. utility; and URENCO, a consortium of the United Kingdom, the Netherlands, and Germany has teamed with Duke Power Company and others to build an enrichment plant in Louisiana using the European gas centrifuge technology. While the U.S. gaseous diffusion plants (GDPs) continue to implement exemplary cost reduction measures, gaseous diffusion technology is energy intensive and our plants will face significant upward cost pressures in a number of areas. The world leadership position in uranium enrichment that the United States has historically enjoyed will be virtually impossible to maintain unless a lower-cost process is effectively deployed. Otherwise, we can ultimately look forward to dependency on foreign suppliers and/or technologies for uranium enrichment. Our control of an important fuel supply will be diminished, and the large investments of U.S. taxpayers in new uranium enrichment technology will have been lost.

With our AVLIS technology, however, the United States is well positioned to sustain a vigorous role. The U.S. version of AVLIS is the world's most promising uranium enrichment process. AVLIS cost projections indicate that an effective transition from gaseous diffusion to AVLIS can be made and that an enhanced market position can be attained for the country. However, we see a number of related issues which, unless they are effectively addressed, can prevent the United States from achieving the full benefit of its investment in AVLIS. These are:

- Market and business issues;
- Institutional issues;
- Deployment issues; and
- Fuel cycle integration and uranium processing issues.

Market and Business Issues

It is important that requirements for AVLIS technology demonstrations and deployment be market driven. Business plans are needed which define economic goals for the initial and subsequent increments of AVLIS production capacity, the timetable for deployment, the appropriate size of the initial plant, and the plan for coordinating the expansion of AVLIS capacity with the GDP phasedown. We recommend completing comprehensive, commercially-oriented business studies now to validate cost estimates being made within the R&D program and to assure that demonstration and plant requirements reflect market needs and opportunities. This information is essential for good decisions about deployment. Technical results alone are insufficient.

Institutional Issues

For decades, the institutional setting of the U.S. enrichment enterprise has hindered its ability to compete in the world marketplace. Certain features of the Atomic Energy Act and the inability to institute a revolving fund or borrow money for capital investments are examples of the barriers which have prohibited the enterprise from operating as a commercial business. Legislation has been proposed which amends the Atomic Energy Act and establishes a Government Enrichment Corporation as a first step to privatization. We support the Government Corporation approach.

In the 1970s, indecisiveness regarding the privatization of uranium enrichment in the United States left many of our customers without an assured supply of enrichment services and created the opening for our European competitors to build new facilities and acquire a substantial share of our market. Our concern today is that once again debate over how to organize the business will delay critical decisions. We are ready to move forward with deployment activities, and we do not believe these should be postponed until the fate of the proposed legislation has been resolved. Our recommendation is to pursue deployment of AVLIS in parallel with Government Corporation legislation efforts. This action will keep the AVLIS demonstration program focused on a deployment objective, provide for rapid deployment by the new corporation, maintain our lead over foreign AVLIS competitors, and demonstrate to the customers our commitment to providing lower costs for enrichment services.

Deployment issues

In November 1988, the Director of LLNL and the President of Energy Systems signed a joint letter to the Department of Energy (DOE) recommending a new initiative for deployment of AVLIS (attachment). The letter stated, "Because of the excellent technical progress in AVLIS . . . and our conviction that early AVLIS deployment is essential . . . it is now our judgement that the AVLIS technology can and should be moved rapidly toward commercial operation." The joint initiative included "establishing a corporate entity to take responsibility for all elements of the recommended program." Together, LLNL and Energy Systems believed that a concurrent demonstration/deployment program under the direction of a commercially-oriented organization provided a means to ensure successful deployment of AVLIS with the maximum benefit to the United States. We still believe that is a sound approach.

Two years ago, when Dr. Davis and I testified before this committee, we elaborated on the November 1988 initiative. As Dr. Davis said then, "a commitment to AVLIS deployment is needed now . . . . A critical element for the successful completion of plant deployment is formation of a capable, profit-oriented, deployment organization. This organization must be one that is composed of the core staff from the demonstration team, augmented with project and business expertise, and supported by a qualified architect-engineering organization."

Subsequently, in January 1990, Secretary Watkins sent a new plan to Congress that set a schedule for AVLIS deployment and called for competitive selection of a Commercial Deployment Contractor (CDC). The competitive selection for the CDC was announced in the Commerce Business Daily, and Martin Marietta formed a very strong team to prepare to respond to the anticipated Request For Proposal (RFP). The team that was assembled combines nuclear and non-nuclear business experience; nuclear facility design experience; licensing experience; fuel cycle expertise; and special capabilities in integrating complex, high-technology projects with demanding cost targets. The team worked for several months and developed an effective strategy for transitioning AVLIS from the laboratory to production. DOE's deployment plan, however, is now evidently on hold. The Administration's

FY 1992 budget contains no funding for deployment activities, emphasizes a Government Enrichment Corporation, and ties AVLIS deployment activities to its formation. As stated earlier, we believe that postponing AVLIS deployment activities until after the formation of a Government Corporation will cause unnecessary program delays and pose a serious risk to both the timing and the credibility of the AVLIS program and thus to the entire enrichment program.

Successfully deploying AVLIS requires a well planned demonstration program that is tightly coupled with deployment objectives. During the past year, the AVLIS program continued to make significant progress toward its goals in all three major technical areas: lasers, separators, and uranium processing:

- The copper laser facility reached power levels of several thousand watts;
- The advanced copper laser chain produced more than 1,000 watts;
- A single dye chain operated in excess of 1,000 watts;
- A separator pod has been operated at plant scale;
- Uranium metal production rates from small metallothermic reduction cells have exceeded expectations; and
- Kilogram quantities of UO_3 for fuel fabricator evaluation have been produced and are being prepared for shipment.

These technical milestones are significant, and they highlight the technical strength that exists within the program; however, they do not fully address issues which are critical to achieving the economic goals demanded by the marketplace. We recommend the immediate involvement of an organization with commercial deployment experience to provide the perspective that will assure AVLIS technology demonstrations are most effectively directed toward critical deployment issues. Working in cooperation with the R&D team, the commercial entity would complete the business studies described earlier, as well as assist with preliminary engineering designs, deployment risk assessments, and detailed plans for licensing, safeguards, security, and environmental, health and safety compliance while instituting a design-to-cost culture and assuring market-driven deployment decisions. We also recommend that DOE's site selection, preparation of the Environmental Impact Statement (EIS), and NRC licensing activities proceed without further delay because they are the pacing activities for AVLIS deployment.

Since a substantial industrial and technology base already exists for AVLIS, we recommend that DOE proceed promptly with its plan to select a single commercial deployment contractor who will be dedicated to addressing the deployment issues and will direct the deployment activities with the entrepreneurial, commercial perspective that we believe is important. The competitive process which was set in motion last year will assure that a qualified CDC will be selected.

Fuel Cycle Integration and Uranium Processing Issues

For the customers of U.S. enrichment services to receive full benefit of AVLIS's superior isotope separation features, nuclear fuel cycle integration must be effectively addressed. AVLIS processes uranium metal whereas gaseous diffusion and gas centrifuge plants process uranium hexafluoride; therefore, integration of AVLIS into the nuclear fuel cycle will be different from existing industry methods (figure 1). However, AVLIS metal-based processing provides opportunities for the nuclear industry to reduce nuclear fuel costs significantly (figure 2) and avoid environmental issues associated with fluoride wastes.

Uranium processing for nuclear fuel has been performed in the private sector for a number of years, and we are committed to maintaining the continued role of private industry in the fuel cycle with deployment of AVLIS. However, as we have consistently been told in our discussions with industry representatives, until AVLIS deployment is certain, the fuel cycle companies are not willing to invest much of their own funds in the necessary advanced uranium processing technologies. Therefore, the program must continue uranium processing demonstration efforts while actively working the interface issues with industry, including technology transfer of the advanced processing methods. I would like to summarize our interactions with the industry to date, including some new information we recently obtained in a survey of all of DOE's utility customers.

Since late 1985, visits have been made to most of the world's feed converters, fuel fabricators, and uranium metal producers to discuss ways by which the AVLIS process could best mesh with these operations. Meetings have been held with many of DOE's utility customers as well, to solicit their input. Currently, all five U.S.-based nuclear fuel fabricators are under contract to evaluate the integration of AVLIS product into their processes and facilities. All five have produced reports which provide their views on acceptance of AVLIS product.

Last month, a comprehensive customer survey by the AVLIS team was also completed, providing utilities the opportunity to input to the program's strategy for AVLIS uranium processing. Utility interest level was very high with 47 out of 59 customers responding. Summarizing the results:

- The customer's main interest is obtaining the lowest overall cost of fuel for their reactors;
- Seventy-five percent of the respondents believed DOE should have responsibility for arranging for metal feed and delivering an acceptable product to fabricators during the initial AVLIS deployment phase;
- There was a strong preference for the AVLIS product to be UF_6 during the initial phase; and
- Once a large AVLIS capacity is in place, most customers want to make arrangements for uranium processing themselves.

Results of this survey, reports from the first phase of the program's contracts with fuel fabricators, and other information from ongoing interactions with the fuel cycle industry have led to our recommendation of new strategies for integrating AVLIS into the nuclear fuel cycle. These strategies minimize the impact on utilities, feed converters, and fuel fabricators during the initial phases of AVLIS deployment and maximize the opportunities for economic and environmental benefits in the longer term. For feed conversion, the entry strategy is for utilities to continue to purchase U_3O_8, and for AVLIS to arrange with existing industry for conversion to metal. The long term strategy is to transfer the continuous metallothermic reduction technology now under development by the program to industry to lower costs and greatly reduce radioactive waste generation (figure 3). For product conversion, the entry strategy is to ensure the availability of facilities to convert UO_3 to UF_6 for those who require it and to provide lower-cost UO_3 directly to those who can accept it. The long-term strategy is to deliver UO_3 product to fuel fabricators (figure 4), provided this option is validated via the ongoing contracts with the U.S. fuel fabricators. Joint AVLIS/fuel fabricator demonstration and acceptance efforts will continue to support this long term strategy.

Effective execution of fuel cycle integration strategies and completion of our uranium processing demonstration program will require sustained program emphasis and industry involvement. We plan to continue aggressive actions toward completing the uranium processing technology demonstrations and continuing interactions with the fuel cycle industry, including transferring the advanced technologies to the private sector. The enactment of technology transfer legislation, and in particular, the advent of Cooperative Research and Development Agreements (CRADAs), have provided an attractive mechanism to place DOE-developed uranium processing technology into the industry.

To summarize my remarks today, Martin Marietta Corporation believes that deployment of AVLIS is important for the long-term success of the U.S. uranium enrichment enterprise. We recommend the following:

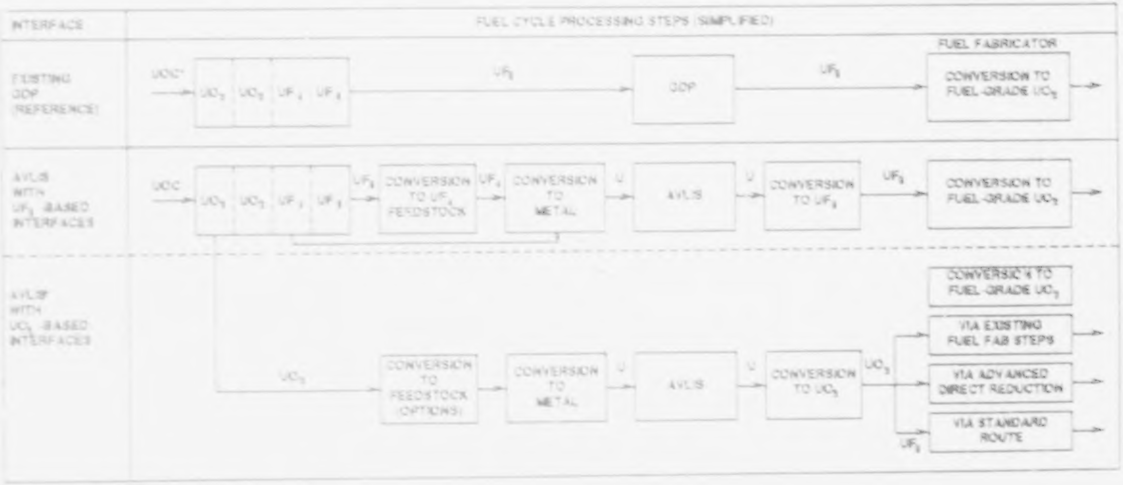
- Completing comprehensive, commercially oriented business studies now to validate program cost estimates and to set both demonstration and plant requirements;
- Pursuing deployment of AVLIS in parallel with Government Corporation legislation efforts to avoid unnecessary and harmful program delays;
- Immediately selecting a single commercial deployment contractor, as per DOE's 1990 AVLIS plan;
- Proceeding with site selection, NRC licensing activities, and preparation of the EIS, since these are on the critical path for AVLIS deployment, and
- Placing a major emphasis on AVLIS fuel cycle integration, including uranium processing technology demonstrations, industry and customer involvement, and transfer of advanced technology to the private sector.

We are excited about the opportunity to assure the long term viability of the U.S. enrichment program and to realize the benefits that AVLIS technology can provide. The U.S. technology base and work force continue to be second to none. With these resources, I believe the United States can once more become the supplier of choice for enrichment customers around the world. The enrichment program is confronted by a number of tough challenges today. However, by facing these challenges squarely, I believe the goal of a healthy U.S. enrichment business can be realized.

On behalf of Martin Marietta Corporation, I thank you again for the opportunity to speak to you today.

Figure 1

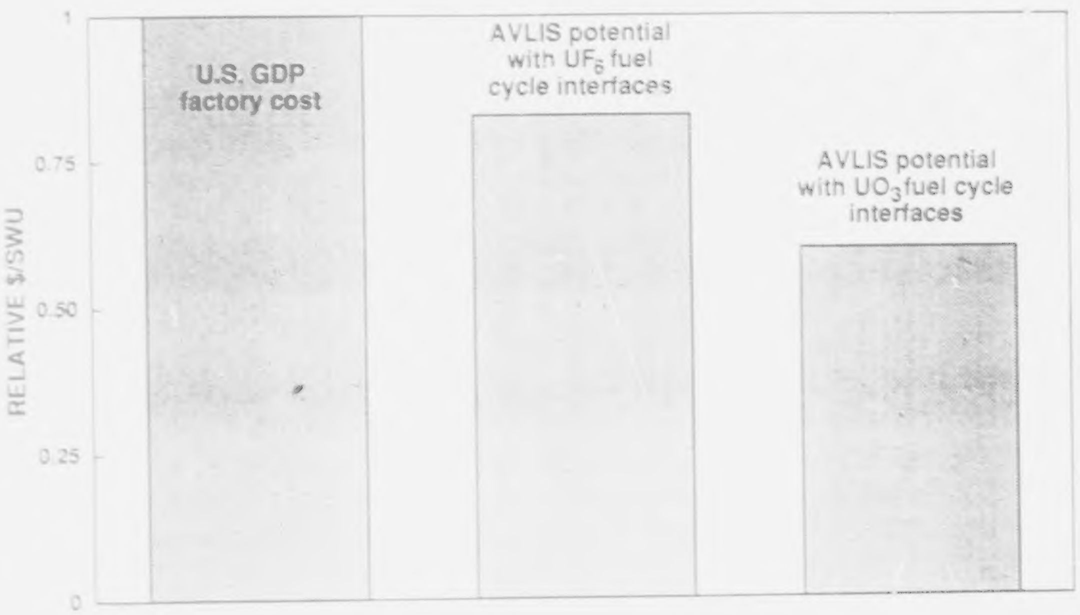
Fuel cycle uranium processing


INTERFACE
FUEL CYCLE PROCESSING STEPS (SIMPLIFIED)
EXISTING GDP (REFERENCE)
UOC*
UO3
UO2
UF4
UF6
UF6
GDP
UF6
FUEL FABRICATOR
CONVERSION TO FUEL-GRADE UO2
AVLIS WITH UF6-BASED INTERFACES
UOC
UO3
UO2
UF4
UF6
UF6
CONVERSION TO UF4 FEEDSTOCK
UF4
CONVERSION TO METAL
U
AVLIS
U
CONVERSION TO UF6
UF6
CONVERSION TO FUEL-GRADE UO2
AVLIS WITH UO3-BASED INTERFACES
UO3
CONVERSION TO FEEDSTOCK (OPTIONS)
CONVERSION TO METAL
U
AVLIS
U
CONVERSION TO UO3
UO3
CONVERSION TO FUEL-GRADE UO2
VIA EXISTING FUEL FAB STEPS
VIA ADVANCED DIRECT REDUCTION
UF6
VIA STANDARD ROUTE

*URANIUM ORE CONCENTRATE FROM MINERS/MILLERS

Figure 2

UO_3 fuel cycle interface significantly lowers AVLIS swu cost



MARTIN MARIETTA

Figure 3

Feed supply strategy

- Entry strategy
  - Utilities continue to purchase U_3O_8
  - AVLIS arranges for the conversion to metal feed via contracts with the existing industry

- Primary strategy for the long term
  - Utilities purchase and deliver uranium metal to AVLIS
  - AVLIS develops and transfers continuous metallothermic reduction process to industry (lower cost, greatly reduced radioactive wastes)

- Major issues
  - Timing of AVLIS deployment (initial and follow on increments)
  - Defining requirements for metal feed (specifications & quantities)
  - Transitioning to a metal-based fuel cycle (utilities' contracts, industry's capitalization of new facilities)
  - Transferring new technology to industry (CRADAs, other mechanisms)

Figure 4

Product supply strategy

- Entry strategy
  - AVLIS provides UF_6 to fabricators
  - AVLIS provides UO_3 to those who will accept it (price discount)

- Primary strategy for the long term
  - AVLIS delivers UO_3 product direct to fabricators
    - Joint AVLIS/fuel fabricator demonstration and acceptance testing to qualify direct reduction to UO_2
    - Fabricators modify facilities to process UO_3

- Major issues
  - Timely qualification of UO_2 via direct reduction route
  - Capital investment required by AVLIS to produce UF_6
  - Capital investment required by fabricators to accept UO_3
  - Definition of UO_3 and UF_6 specifications
  - Transitions to oxide product

MARTIN MARIETTA

University of California
Lawrence Livermore
National Laboratory

MARTIN MARIETTA
MARTIN MARIETTA ENERGY SYSTEMS, INC.

November 23, 1988

Ms. Jo Ann Elferink, Manager
Department of Energy
San Francisco Operations Office
1333 Broadway Street
Oakland, CA 94612

Mr. Joe La Grone, Manager
Department of Energy
Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, TN 37831-8501

Dear Ms. Elferink and Mr. La Grone:

New Initiative for the Uranium Atomic Vapor Laser Isotope Separation Program

Lawrence Livermore National Laboratory and Martin Marietta Energy Systems are pleased to recommend a new initiative for the national Atomic Vapor Laser Isotope Separation (AVLIS) program. Because of the excellent technical progress made in AVLIS since the Secretary's 1985 process selection and our conviction that early AVLIS deployment is essential to protect important United States commercial, technological and strategic energy interests, it is now our judgement that AVLIS technology can and should be moved rapidly toward commercial operation.

Specifically, we recommend that the United States immediately embark on an integrated plan capable of introducing AVLIS into the international enrichment marketplace by the end of 1995. This plan is based on an integrated, cooperative effort that couples activities associated with design and demonstration of plant prototypic systems to the design and operations planning for the plant itself. Insight and design criteria that are important from a plant perspective, such as those related to regulatory issues, safeguards, or other areas of assurance, will be identified early and fed into the activities surrounding prototype hardware design and test.

The success of this proposed program will depend on the Department's initiation and support of two crucial activities. Namely:

- Targeting a goal for the Environmental Impact Statement (EIS) Record of Decision at the end of 1991, at which time plant construction activities can begin. This requires very near-term initiation of the process for selection of a preferred site with a decision in early 1990.

- Again, in the near term, establishing a corporate entity to take responsibility for all elements of the recommended program. In this role, the designated corporation will establish a framework conducive to attracting the personnel who are essential for program success, including the key members of the current AVLIS team. This organization will direct the deployment efforts from the perspective of an industrial entrepreneurial and profit-oriented corporation.

The cost of this plan through the Record of Decision is projected to be approximately $500 million. This includes the already appropriated FY89 funds.

The plan we propose has several important attributes:

- It is tuned to the needs of the marketplace and preserves the ability of our country, in a critical time window, to sell enrichment services at attractive rates.
- It protects options for long-term energy security, national security, and competitiveness in the enrichment arena.
- It includes numerous check-points where assessments can be made regarding the continuing pace, scope, and direction of the program. These check-points will consider the details of designs and cost estimates, technology demonstration results, market conditions, and ongoing business evaluations.
- It effects risk reduction and technology transfer by integrating demonstration and design hardening tasks with parallel deployment activities, and emphasizes a profit orientation in a major national DOE program.

Previous DOE AVLIS plans have been based on a more serial and compartmentalized approach to technology demonstrations and plant deployment. Costs for this newly proposed integrated plan, through completion of plant deployment, are projected to be reduced by approximately $500 million.

The MMES/LLNL team has worked together on AVLIS for the past thirteen years and has developed an outstanding working relationship. We are now formulating a detailed plan for implementing the new deployment organization.

We appreciate the confidence represented by the Government's significant investment in AVLIS during these years and recognize the important obligation we have to its future success. We are convinced that early introduction of AVLIS into the marketplace is an essential element for keeping the United States competitive in uranium enrichment and we pledge to continue our full support in reaching this challenging goal.

Sincerely,

Clyde C. Hopkins
C. C. Hopkins
President
Martin Marietta Energy Systems, Inc.

John H. Nuckolls
John H. Nuckolls
Director
Lawrence Livermore National Laboratory

Mrs. LLOYD. Well, Dr. Merriman, you couldn't express my feelings any better than if I had said them myself. I appreciate your comments and certainly your ability and your knowledge.

Mr. Miles.

STATEMENT OF EUGENE J. MILES, DIRECTOR, FUEL CYCLE MATERIALS AND SERVICE DEPARTMENT, WESTINGHOUSE ELECTRIC CORP.

Mr. MILES. Thank you, Madame Chairman. I want to thank you and the members of the committee for this opportunity to address you this afternoon.

I think we all know—everyone in this room, that the DOE has lost market share and is continuing to lose market share to foreign competition. We have also heard Dr. Davis speak about competition in the laser enrichment area, the Japanese and the French.

Again, if we delay and they, the foreign competition are successful, the DOE is going to lose more market share in the enrichment business.

You, yourself, Madame Chairman, this afternoon mentioned GCEP. I can recall that there was some money that had been wasted there, up to the tune of $2 billion. It wasn't so much that the centrifuge technology was wrong because other people are using it. What was wrong was we were trying to use a large centrifuge when the rest of the world was going to a small centrifuge. URENCO, and we believe the Soviet Union, is doing the same thing. So there were successes with that type of technology.

Now we have another chance and we don't want to make the same commercial and technical mistakes that we made with GCEP and centrifuge.

So Westinghouse is here to strongly urge you to restore the funds in the fiscal year 1992 budget request for an AVLIS commercial deployment contractor. We believe this is an essential ingredient to achieve a timely, realistic assessment of the commercial viability of AVLIS. The AVLIS process appears to offer the potential for a significant reduction in the cost of enriching uranium. As such, it could reduce the cost of generating nuclear power. However, having this potential is not enough to justify continuing a research program to develop AVLIS.

The decision to continue its development should be based solely on sound economic and business principles. The program is at a critical point. Lawrence Livermore is scheduled to complete a full-scale demonstration in 1992. Everyone thinks that the U.S. is still ahead of foreign competition. We are concerned that recent delays in requesting proposals for a commercial deployment contractor will preclude Westinghouse and other qualified bidders from contributing our expertise at this time.

We therefore urge Congress to take those actions that will lead to a timely realistic assessment of the commercial viability of AVLIS, and cause the future development effort to be focussed in those areas that are most important to commercial success.

Westinghouse agrees with the DOE. You must have a realistic assessment of the capital costs and the operating costs. It must demonstrated on a full scale. The 1992 budget submittal takes care of that. It is focused heavily on providing information related to those issues, but we have to have firm estimates about the market. We have to have estimates about when the product is going to be delivered. How it will interface at all the different levels.

It is not just we are going to produce this product, whatever it might be, and it is going to go out there into the marketplace, one of the things that we have to remember is that when you put AVLIS into the system, it is not going to be the dominant technology. You might have a million; you might have two million SWUs. The rest of the world is a different technology.

So we have to realize that we have to think about what are the competitors going to be doing that are going to be competing with AVLIS. What are their strategies?

Most importantly, we have to assess what our customers, the utilities, will think about the risks associated with the fuel assemblies that they are going to have this AVLIS product in their assemblies.

So I just want to take one segment of this because I am most familiar with it. It is fabrication of fuel. The nuclear industry has to be confident of the product of the AVLIS process. Whether it is UF6 gas, UO3 oxide, UO2 powder or uranium metal, it has got to be reliable. It has to be economically converted into fuel pellets that will perform well in the reactors.

Westinghouse considers the selection of the form in which AVLIS will send its product to the fuel fabricators to be an important quality and fabrication cost issue. So we consider this choice to be still open at this point in time. It hasn't been clearly defined. At one time, it was UO3 oxide. Now we are talking about UF6 gas, I am told.

Whether it is gas or oxide or powder, each one of these things has advantages and disadvantages. They are related to quality and maybe new capital investment. If you stick to gas, there is not going to be any investment problems or any quality problems, because that is what fabricators use. But if you go to UO2 powder or UO3 oxide, it could create problems for us.

So you need to find out what are the interface problems? We need to look at our processes. The people who are producing the AVLIS product may have to change things. The fabricators may have to change something. There may be investments to be made. So then you have to look at the total fuel cycle cost. It is not just the cost of the enriched uranium or enriching uranium. It is the total cost in the fuel cycle that has to be looked at. That is what a commercial deployment contractor can do and he can do best.

If UO3 or UO2 were the final product, you would have to have very close coordination between the AVLIS people and the fabricators in this country. What we are looking at is probably a two-year program. It is not something that happens over night. The point is that you have to decide what the form of the product is going to be and then you may have an extended period of time that you have to develop the interfaces which are very important. That is just one small example that I picked out.

We are saying that we feel that a commercial deployment contractor is the best way to do this. He will look at all of the issues, all of the interfaces. So we strongly urge you to reinstate the funding and let us get on with it and not make the mistakes that we have made in the past with other programs. I have heard other people say, and maybe even some of it mentioned today that there is still time. I am not so sure we haven't already run out of time. I like to think we haven't. The time is now. We don't need the delay. We need the funds restored. We need a deployment contractor.

Thank you very much.

[The prepared statement of Mr. Miles follows:]

Testimony by

EUGENE J. MILES

Director, Fuel Cycle Materials & Services
Energy Systems Business Unit
Westinghouse Electric Corporation

before the

United States House of Representatives
Committee on Science, Space, and Technology
Subcommittee on Energy

April 10, 1991
Washington, D.C

Madam Chairman, Honorable Members of the Committee, Ladies and Gentlemen:

My name is Gene Miles. I am the Director of Fuel Cycle Materials & Services for Westinghouse Electric Corporation and will present Westinghouse's perspective on the Atomic Vapor Laser Isotope Separation (AVLIS) program for uranium enrichment.

DOE is rapidly losing market share of its commercial uranium enrichment business to international competition. Foreign government sponsored AVLIS technology programs will hasten its demise, if they are brought to the marketplace before the U.S. program. Specifically, we urge you to restore the funds in the FY'92 budget request for a U-AVLIS Commercial Deployment Contractor (CDC) program. We believe this to be an essential ingredient to achieve a timely, realistic assessment of the commercial viability of U-AVLIS.

Westinghouse, as you know, is a leading supplier of equipment and services to the commercial nuclear power business and manages nuclear related facilities for the DOE. We are a significant segment of the commercial industry, having designed, built or licensed over 40% of the entire world's reactors currently in operation. With regard to nuclear fuel, we are currently fabricating over 35% of the fuel it takes to run the domestic plants. Therefore, the long-term future of enriched uranium for domestic use is of vital concern to our corporation and our customers.

For several years, Westinghouse has supported Lawrence Livermore National Laboratory (LLNL) in the development and demonstration of the AVLIS technologies and related engineering tasks. We have had as many as 65 personnel in residence at LLNL on the program. We have participated in a technology transfer program since 1986 in all aspects of the process.

The AVLIS process appears to offer the potential for a significant reduction in the cost of enriching uranium and, as such, could reduce the cost of generating nuclear power.

However, having this potential is not enough to justify continuing a research program to develop AVLIS. The decision to continue its development should be based solely on sound economic and business principles.

The program is at a critical point. LLNL is scheduled to complete a demonstration on significant size equipment this year. We think that the U.S. is still ahead of the foreign competition but are concerned that recent delays in requesting proposals for a Commercial Deployment Contractor will preclude us and other qualified bidders from contributing our expertise at this time. We urge Congress to take those actions that will lead to a timely, realistic assessment of the commercial viability of U-AVLIS and cause the future development effort to be focused on those areas most important to commercial success.

Westinghouse agrees with the DOE that a realistic assessment requires confidence in capital and operating projections based on demonstrated experience at a significant scale. The program described in the FY'92 budget submittal focuses heavily on providing information related to these issues.

However, beyond this, a realistic assessment requires a firm estimate of the market for AVLIS enrichment services. This market will be determined by the quantity and price of AVLIS SWU's in comparison with those from other processes. Also, it will be dependent upon when the AVLIS SWU's will be deliverable to its customers, marketing and expansion strategies of AVLIS's competitors, and most importantly, upon an assessment by the utilities of the risk associated with putting into their reactors the fuel assemblies with AVLIS enriched uranium.

There are numerous elements in the risk assessment --- total fuel cycle cost impact, surety of schedule (for the enrichment and for fabrication), surety of fuel quality and possible reactions of the NRC or Public Utility Commissions to any change in existing operations resulting from the change in enrichment method --- to name only a few.

Westinghouse understands well the issue of fuel quality. The nuclear industry must be highly confident that the product of the AVLIS process --- whether it be UF6, UO3, UO2, or uranium metal --- can be reliably and economically converted into fuel pellets that will perform well in reactor service. Westinghouse and its customers today have that confidence in its product. The United States Department of Commerce also has that confidence. Nearly three years ago, the Westinghouse Commercial Nuclear Fuel Division, a fully integrated nuclear fuel manufacturing organization, was given the first annual Malcolm Baldridge Award for its total quality program.

Westinghouse considers the selection of the form in which AVLIS will send its product to the fuel fabricators to be an important quality and fabrication cost issue. And, we consider the choice to be still open at this point in time.

UF6, UO2, and UO3 each have inherent advantages and disadvantages. UF6 product avoids questions related to quality and the need for new capital investment in the fabrication industry, since it would leave the fabricator's process essentially unchanged as long as the product met the current UF6 specifications. UO3 and UO2 appear to offer a potential cost reduction using the AVLIS process, because of the elimination of several intermediate chemical processes. However, if UO3 or UO2 are to be the final AVLIS product, Westinghouse envisions the need for a closely coupled effort between the AVLIS developers and the fuel fabricators. In this effort, the fabricators would try various chemical conversion and pellet making processes to determine how best to handle the particular form of product produced by AVLIS. Process changes on the part of both AVLIS and the fuel fabricators will probably be required to achieve the quality and reliability of the process, together with reasonable investment and operating costs required.

This demonstration of AVLIS product quality, in conjunction with fuel fabricators, is likely to take at least two years --- and it is vital to assessing commercial viability, if the AVLIS product is to be something other than UF6.

Once again, Westinghouse urges Congress to reinstate funding for the Commercial Deployment Contractor (CDC) program in the 1992 budget. This is the best mechanism available to assure that a meaningful assessment, not only of AVLIS plant costs and production costs, but also of the market's sensitivity to SWU price and time. It may also show that the AVLIS product can be reliably and economically converted to high quality fuel pellets and that other utility customer concerns are adequately addressed in the AVLIS commercialization plans.

In his testimony before the U.S. Senate's Subcommittee on Energy Research and Development, Committee on Energy and Natural Resources, William H. Young, DOE Assistant Secretary for Nuclear Energy, stated that "Government expenditures for U-AVLIS predeployment activities have not been included in the Administration's FY 1992 budget," because "the Government should avoid investments in the uranium enrichment enterprise that could more appropriately be made by the private sector." This testimony was given in support of legislation that would authorize the formation of a Government Corporation for Uranium Enrichment.

This Corporation would own the U-AVLIS technology and would direct its commercialization. The CDC program is therefore stalled until legislation creates the Corporation and the Corporation decides to invest and deploy the technology on its own.

Westinghouse is supportive of the concept of a Government owned uranium enrichment company. Delays in the formation of the Government Corporation should not delay moving U-AVLIS from a technology driven to a market driven program. Nor, should it delay bringing a sound business and marketing voice to the ear of the decision-makers, be they DOE or a Government Corporation.

The AVLIS CDC program can be initiated and operated in parallel with a Government Corporation for as long as is advantageous. A delay at this time could be fatal to any future success. Researchers in both France and Japan are closing fast on this Country's technology lead with their government supported programs. Now is not the time for delay and procrastination; now is the time for action.

Westinghouse and I thank you for this opportunity to present our views to you. I am pleased to answer any questions.

EUGENE J. MILES

Mr. Miles is Director, Fuel Cycle Materials & Services for Westinghouse Electric Corporation.

He joined Westinghouse in 1968 as Assistant Manager of Operations - Nuclear Fuel Division and since that time has held various management positions in Nuclear Fuel Manufacturing and Uranium Mining and Production. In 1982, Mr. Miles became President of Wyoming Minerals Corporation, a Westinghouse subsidiary and in 1984 was appointed General Manager, Uranium Resources Division. He assumed his present position in 1989.

Mr. Miles received his B.S. degree in industrial management in 1953 and his M.B.A. degree in 1961, both from the University of Pittsburgh. He is Chairman of the USCEA Nuclear Fuel Supply Committee.

Mrs. **Lloyd**. Thank you for an excellent statement.

Mr. Morrison.

Mr. **Morrison**. I guess I still have some—certainly not about the fundamentals here, but since we have such an interesting combination, Dr. Davis, who has led us through absolutely some fascinating things at Lawrence Livermore and, of course, the two major corporations here are highly respected.

At what point could we ask an enrichment enterprise to take on AVLIS and still have them potentially keep their head above water financially. There is a Government investment and I think we have heard at least the last two witnesses say, "Get it transferred to one of us. We'll fight over it. Then we'll develop it and be in a position to pass it off to the enterprise."

But at some point, we have to help draw that line. I think OMB would push it very dramatically in one direction. That is part of the uncertainty now. Some of us would push it pretty aggressively in the other.

Can you help us in that wrestling match?

Dr. **Davis**. Mr. Morrison, my comment on that would be that that is exactly the question we want to get answered by having a deployment contractor get involved with the laboratory. We can make statements about that. We can make projections about it. We do make statements and projections, but the reality is that only a deployment contractor can make the kind of statements that will deal with all of the interfaces that the gentleman from Westinghouse just described.

So it is going to remain somewhat nebulous until we get a full deployment team put together and not just the technology organization.

Mr. **Morrison**. Then we are better off from the point of view of making the enrichment enterprise work if we have somebody with a private enterprise hat in that intermediary role.

Dr. **Davis**. They need to be involved. They should have been involved years ago. They need to be involved as soon as possible simply because the R&D organizations do not work that part of the territory, so to speak.

Mr. **Morrison**. I was intrigued with the comment from this panel that if we pause to deploy, we lose any advantage we have. In other words, you can only make a selection and then carry it on without giving everybody the chance to catch up with us.

Dr. **Davis**. Right. That's a major factor. Mr. Wolpe is gone now, but he was raising the questions earlier about the technology demonstration and what is at scale. We built the large laser facility that you toured when you were at Livermore back in 1985 and 1986. We turned it on at that time. That facility has been in life cycle testing now for some four or five years. The freeze on the particular technology was a 1985 technology.

Now we are demonstrating not a full facility, but beam lines. Remember, those are multiple modules that are in there. So for the demonstration in 1992, we are building a module of the advanced technology which will produce more power more efficiently at lower cost. But we are not building a whole new laser facility to do that. We are doing the component by component, subsystem by subsystem demonstration rather than going out and building an entirely new facility.

So technology just moves on. Whether it is videocassette recorders, whether it is television sets, micro chips or whatever. AVLIS is no different.

So if we don't deploy in a timely way, inflation or a competitor will simply produce a better product.

So that was the intent of the statement.

Mr. MORRISON. Maybe this is philosophical as much as practical, but we have a dickens of a time—and I have seen it time and time again on this committee where we develop the technology, have a big face-off as to which part—in fact, AVLIS itself is a winner—from the enrichment options. Then we put all of our money on one horse, but don't put enough on so you never win.

I think I hear you, Dr. Davis, arguing to get this off of our hands. We have taken it as far as we should, so we can go ahead and crank on some other new technologies that will be the next phase.

Dr. DAVIS. That is exactly correct.

Mr. MORRISON. You are certainly being backed up by your private enterprise counterparts that are saying get it to us so we can have the interface with the real world, the business world.

Thank you, Madame Chairman.

Mrs. LLOYD. Thank you very much, Mr. Morrison.

There are a couple of questions that I just want to run through basically for the record with you gentlemen. I want to start with you, Dr. Davis, and get a little more in-depth understanding on the issue of scale of the demonstration.

Just for the record, tell us how you plan to reconcile the demonstration to plant size operation?

Dr. DAVIS. The AVLIS process is a modular process. To build a laser, you develop one module and then you stack a lot of modules together. To build a separator, you build one pod and you stack a lot of them together.

So the purpose of the demonstration is two-fold. It is to show that those modules that you use to stack up to build an entire plant are fully demonstrated at plant scale.

Now the gentleman from GAO probably is thinking about the fact that not all life cycle testing will be done. Life cycle testing has to do with the operating cost of the plant. In other words, insofar as you run units and in the meantime between repair, it becomes longer and longer, then the operating costs get lower and lower and lower. So we will not have run all the equipment at the predicted operating point of the plant for full life cycle testing. That will continue after 1992.

Now we have run equipment at full life cycle testing scale, but not the particular prototype equipment for the plant. The ongoing equipment that you see in the existing facility out there that was put in in 1986, the accumulated 1.5 million hours of operating life on the copper paper laser. So I don't think there is any doubt in the technical community's mind that we will achieve the life cycle goals. So it will be full scale, but not full life cycle testing, if that is a word.

Does that help?

Mrs. **Lloyd**. Very good. One other thing I'd like for you to clarify, Dr. Davis is the RFP for deployment contractors as we discussed earlier, it was prepared. Yet, you are recommending a two-team approach to select this contractor. What benefit does this give? Doesn't it just delay the process?

Dr. **Davis**. In my recommendation, just to be sure I am clear is that the only way that I am aware of that we could move quickly to bring industry in to provide some of the information and to provide proposals to the Government of what they think is appropriate is through the national competitiveness and technology transfer act.

My view is that since you are looking for ideas and you are looking for points in the proposals, that you ought to have at least a couple of teams provide their ideas and proposals. It is at a rather modest cost to the Government for such a big decision that the sooner we can get that kind of information, the better. My estimate is that it would probably take 12 to 18 months for those teams to provide the kind of information. I am not opposed to the CDC selection process, but I think it is going to be a fairly protracted process. I am just proposing that there may be an alternative faster way to get industry involved.

Mrs. **Lloyd**. I share your feelings, but I also agree with Mr. Miles that we are almost at the jumping off place. It is getting a little perilous at times. I am a little apprehensive about delays more than we are already facing at the present time.

Dr. Merriman, I would like for you and Dr. Davis both to discuss some of the activities that you think that we should be pursuing in 1992. I would like to also get back on the deployment issue.

What is the bottom line that you feel we could live with?

Certainly, we can't move ahead with all of the funding that we would like to do.

What do you basically feel is the bottom line?

You may want to reply in writing to this one. What is the level of funding that you feel that you could move ahead with some of the deployment activities?

Dr. **Merriman**. We will certainly look hard at that in response to your question, but I would support the number that Dr. Davis provided earlier of a minimum of $20 million to $25 million in fiscal year 1992. I might also add that I think to meet that schedule and spend that money effectively, DOE should go ahead and release the RFP and make an accelerated procurement decision to select a CDC.

Mrs. **Lloyd**. Do you want to comment on that, Mr. Miles?

Mr. **Miles**. As far as funds, I don't really have any comment. I think that the range of funds is probably appropriate at $20 to $25 million.

As far as the scope, it is pretty much the scope that is outlined in my testimony. We need to have people look at strategies and tactics. I know that sounds very general, but that is really what it is.

It is looking at: What does it mean if you are only going to bring 1 million or 2 million of AVLIS SWUs into the system?

What if it is a different form than gas?

If it isn't a different form and it is gas, what does it cost?

Because the product of AVLIS is metal. Getting metal to gas costs money. That becomes a different cost within the fuel cycle.

So all of these things would have to be looked at by a deployment contractor. I mean we finally have to nail down what it is that we are going to take into AVLIS and what it is that we are going to produce out of AVLIS. All of those things must be nailed down, or you can't really have a fuel cycle cost estimate.

Mrs. LLOYD. That is one of your major criticisms and also one of the major criticisms of the GAO.

Dr. Merriman, what are we really doing to resolve some of these issues?

What is the status of that part of the program involving industry and these decisions?

Is there anything that we are doing in this area?

Dr. MERRIMAN. Yes, ma'am. I would be pleased to summarize that for you. Since 1985, we have recognized that it is essential to involve the existing industry in decisions affecting how AVLIS couples with the nuclear industry. We have had a lot of activity in that area. For example, we have made visits to most of the world's feed converters, fuel fabricators, and uranium metal producers to review the program and discuss ways by which the AVLIS process could best mesh with their operations. We have had meetings with many utility customers as well to solicit their input.

Currently, all five U.S. based nuclear fuel fabricators are under contract to us to evaluate the integration of AVLIS product into their processes and their facilities. All five have produced reports which provide their preliminary views on acceptance of AVLIS product. We are continuing our interactions with them.

Last month, we also completed a comprehensive customer survey where we went out and canvassed all of DOE's utility customers to allow them a chance to provide their input to our strategy for phasing AVLIS in the front end and the back end. Eighty-five percent of the customers responded to that. So we are getting good input. We will continue to do that. We pledged that we will work hard with the utilities and the fuel cycle industry to assure that the utilities get the lowest total cost of nuclear fuel with AVLIS. So their input is very important to us.

Mrs. LLOYD. I am very pleased with that level of industry involvement. Certainly, the direction that this committee would like to see you move in. Certainly, it is to the advantage of all of those involved in the AVLIS program.

Mr. Miles, if our enrichment enterprise ceased to exist, it would impact seriously the mining and the conversion industries. It would pretty impact the fabricators as well, wouldn't it?

Mr. MILES. If there was no DOE enrichment enterprise?

Mrs. LLOYD. That is correct.

Mr. MILES. I think it would be a serious blow to the domestic nuclear industry. At the same time, one has to realize that the world is a small place in terms of enrichment. A lot of times, a utility customer, all he looks at is price. That is why AVLIS is so important as a technology break-through. Lower cost will be a breakthrough for DOE.

Right now, all the gas that comes into a fabricator looks the same, whether it came from the Soviet Union, the French, the English or the United States. They all have to meet the same specifications. Many utilities, as I say, just buy on a price basis.

Yes, it would be a disaster not to have a U.S. business.

Mrs. Lloyd. I appreciate your input and your testimony. Again, we will have some questions in writing for the record. We will continue to look to your expertise and your counsel.

Any further questions?

Are there any further comments that you gentlemen would like to make?

[No response.]

Mrs. Lloyd. If not, I thank everyone for participating in our hearing today. I would like to thank the staff for the excellent job in putting together our hearing.

If there is no further comments, the subcommittee stands adjourned.

[Whereupon, at 3:38 p.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

APPENDIX I

SUBCOMMITTEE MARKUP OF H.R. 2399, ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT AUTHORIZATION ACT OF 1991

THURSDAY, APRIL 25, 1991

House of Representatives,
Committee on Science, Space, and Technology,
Subcommittee on Energy,
Washington, DC.

The subcommittee met, pursuant to notice, at 10 a.m., in room 2318, Rayburn House Office Building, Hon. Marilyn Lloyd (Chairman of the subcommittee) presiding.

Mrs. Lloyd. The subcommittee will come to order.

Good morning ladies and gentlemen. I am pleased to welcome you to the Subcommittee markup of the Energy Technology Research and Development Authorization covering Fiscal Years 1992 and 1993. As you know, it has been a long time since we have passed an authorization bill for energy research and development. In my view it has been too long. Under the leadership of our new chairman, Mr. Brown, I am optimistic that this year we will succeed in getting our authorization enacted into law.

The draft bill we have before us today takes recognition of the fiscal stringencies that face us as a result of the budget resolution adopted last fall. The proposed authorization has been constructed to meet the overall guideline targets set for our energy technology programs, but of course there are many things that are not included that we would like to have. There are things that we would all like to include but if this is to be a meaningful bill, we must display discipline and maintain those ceilings. I hope everyone will cooperate.

The draft authorization before us speaks to the energy technologies that we will be developing during the last decade of this century. In so doing it provides a sense of direction consistent with the goals of the National Energy Strategy. It proposes further the development of technologies to enhance our ability to use our own natural resource base of coal in an environmentally acceptable manner. It also provides for a more accelerated program for enhanced oil recovery to increase domestic production of oil and also for increased development efforts for the production and applications of natural gas.

The draft bill likewise provides support for the nuclear energy research and development, in support of the National Energy Strategy objectives to increase the role of nuclear power in meeting our future electric power needs. Also included is modest funding for research and development related to nuclear waste.

The bill also contains provisions to expedite the transfer of the AVLIS technology from the DOE laboratories to the private sector. Authorization is provided for an industrial contractor to participate in the concept demonstration of the technology and to provide an assessment of its economic competitiveness and design effectiveness for commercial operation. In addition, the laboratories responsible for research and development are encouraged to enter into cooperative research and development agreements to spinoff this technology to American industry for non-uranium application.

The proposed bill supports the request for the fusion energy program as it shifts from basically a research program to a technology development program.

The bill also supports the goal of the National Energy Strategy for fortifying foundations by supporting the request for the basic energy sciences programs. A modest increase is proposed in university and science education for nuclear engineering education and university reactors. Finally, the bill authorizes funding to continue operation of the fast flux test facility while support is being sought from outside sources for the research reactor user center.

I believe this bill will help achieve the goals of our National Energy Strategy by furthering those technologies critical to our Nation's energy future.

Before I recognize our ranking Republican member, Sid Morrison, for his opening remarks, I want to clarify our procedures today. The package before you today contains an agenda, a draft bill—which we will use a markup vehicle— a draft report, and a summary budget table. Our staff director, Frank Murray, will give a brief description of the provisions of the bill, and then the bill will be open for amendment.

I will be offering an amendment en bloc. The amendment will correct some drafting errors in the markup vehicle sent to you previously. Most of the amendments are technical and conforming in nature, however, I will discuss four separate additional items included in the amendment at the appropriate time.

Following my amendments, other members may offer amendments to the bill. We will then discuss the report and any new language offered by members.

[The prepared opening statement of Mrs. Lloyd follows:]

HON. MARILYN LLOYD
OPENING STATEMENT
SUBCOMMITTEE ON ENERGY - MARKUP
ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT AUTHORIZATION ACT OF 1991

APRIL 25, 1991

I AM PLEASED TO WELCOME TO THE SUBCOMMITTEE MARKUP OF THE ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT AUTHORIZATION COVERING FISCAL YEARS 1992 AND 1993. AS YOU KNOW, IT HAS BEEN A LONG TIME SINCE WE HAVE PASSED AN AUTHORIZATION BILL FOR ENERGY RESEARCH AND DEVELOPMENT. IN MY VIEW IT HAS BEEN TOO LONG. UNDER THE LEADERSHIP OF OUR NEW CHAIRMAN, MR. BROWN, I AM OPTIMISTIC THAT THIS YEAR WE WILL SUCCEED IN GETTING OUR AUTHORIZATION ENACTED INTO LAW.

THE DRAFT BILL WE HAVE BEFORE US TODAY TAKES RECOGNITION OF THE FISCAL STRINGENCIES THAT FACE US AS A RESULT OF THE BUDGET RESOLUTION ADOPTED LAST FALL. THE PROPOSED AUTHORIZATION HAS BEEN CONSTRUCTED TO MEET THE OVERALL GUIDELINE TARGETS SET FOR OUR ENERGY TECHNOLOGY PROGRAMS. BECAUSE OF THESE CONSTRAINTS, THERE ARE MANY THINGS THAT ARE NOT INCLUDED THAT WOULD BE NICE TO HAVE. I AM SURE THERE ARE PROJECTS THAT WE WOULD ALL LIKE TO SEE ADDED TO THE AUTHORIZATION. HOWEVER, IF THIS AUTHORIZATION BILL IS TO BE A MEANINGFUL STATEMENT, THEN WE MUST DISPLAY DISCIPLINE AND MAINTAIN THOSE OVERALL AUTHORIZATION LEVELS THAT APPROXIMATE OUR BUDGET CEILING. I WILL NEED THE COOPERATION AND HELP OF EACH OF YOU IF WE ARE TO STAY WITHIN THOSE LIMITS.

THE DRAFT AUTHORIZATION BILL BEFORE US TODAY SPEAKS TO THE ENERGY TECHNOLOGIES THAT WE WILL BE DEVELOPING DURING THE LAST DECADE OF THIS CENTURY. IN SO DOING IT PROVIDES A SENSE OF DIRECTION CONSISTENT WITH THE GOALS OF THE NATIONAL ENERGY STRATEGY. IT PROPOSES TO FURTHER THE DEVELOPMENT OF TECHNOLOGIES TO ENHANCE OUR ABILITY TO USE OUR OWN NATURAL RESOURCE BASE OF COAL IN AN ENVIRONMENTALLY ACCEPTABLE MANNER. IT ALSO PROVIDES FOR A MORE ACCELERATED PROGRAM FOR ENHANCED OIL RECOVERY TO INCREASE DOMESTIC PRODUCTION OF OIL AND ALSO FOR INCREASED DEVELOPMENT EFFORTS FOR THE PRODUCTION AND APPLICATIONS OF NATURAL GAS. THESE TECHNOLOGIES ARE CRUCIAL TO ACHIEVING THE GOALS OF THE NATIONAL ENERGY STRATEGY AND REDUCING OUR RELIANCE ON IMPORTED OIL.

THE DRAFT BILL LIKEWISE PROVIDES SUPPORT FOR THE NUCLEAR ENERGY RESEARCH AND DEVELOPMENT, IN SUPPORT OF THE NATIONAL ENERGY STRATEGY OBJECTIVES TO INCREASE THE ROLE OF NUCLEAR POWER IN MEETING OUR FUTURE ELECTRIC POWER NEEDS. ALSO INCLUDED IS MODEST FUNDING FOR RESEARCH AND DEVELOPMENT RELATED TO NUCLEAR WASTE; NUCLEAR WASTE IS ONE OF THE MOST DIFFICULT LONG TERM CHALLENGES TO NUCLEAR POWER AND UP TO NOW WE HAVE NOT HAD A COORDINATED RESEARCH AND DEVELOPMENT PROGRAM TO ADDRESS THIS PROBLEM.

THE BILL ALSO CONTAINS PROVISIONS TO EXPEDITE THE TRANSFER OF THE AVLIS (ATOMIC VAPOR LASER ISOTOPE SEPARATION TECHNOLOGY) FROM THE DOE LABORATORIES TO THE PRIVATE SECTOR. AUTHORIZATION IS PROVIDED FOR AN INDUSTRIAL CONTRACTOR TO PARTICIPATE IN THE CONCEPT DEMONSTRATION OF THE TECHNOLOGY AND TO PROVIDE AN ASSESSMENT OF ITS ECONOMIC COMPETITIVENESS AND DESIGN EFFECTIVENESS FOR COMMERCIAL OPERATION. IN ADDITION, THE LABORATORIES RESPONSIBLE FOR RESEARCH AND DEVELOPMENT ARE ENCOURAGED TO ENTER INTO COOPERATIVE RESEARCH AND DEVELOPMENT AGREEMENTS TO SPINOFF THIS TECHNOLOGY TO AMERICAN INDUSTRY FOR NON-URANIUM APPLICATION.

THE PROPOSED BILL SUPPORTS THE REQUEST FOR THE FUSION ENERGY PROGRAM AS IT SHIFTS FROM BASICALLY A RESEARCH PROGRAM TO A TECHNOLOGY DEVELOPMENT PROGRAM.

THE BILL ALSO SUPPORTS THE GOAL OF THE NATIONAL ENERGY STRATEGY FOR FORTIFYING FOUNDATIONS BY SUPPORTING THE REQUEST FOR THE BASIC ENERGY SCIENCES PROGRAMS. A MODEST INCREASE IS PROPOSED IN UNIVERSITY AND SCIENCE EDUCATION FOR NUCLEAR ENGINEERING EDUCATION AND UNIVERSITY REACTORS. FINALLY, THE BILL AUTHORIZES FUNDING TO CONTINUE OPERATION OF THE FAST FLUX TEST FACILITY WHILE SUPPORT IS BEING SOUGHT FROM OUTSIDE SOURCES FOR THE RESEARCH REACTOR USER CENTER.

I BELIEVE THIS BILL WILL HELP ACHIEVE THE GOALS OF OUR NATIONAL ENERGY STRATEGY BY FURTHERING THOSE TECHNOLOGIES CRITICAL TO OUR NATIONS ENERGY FUTURE.

THIS YEAR WE WILL BE SENDING OUR SUBCOMMITTEE MARKUP TO THE FULL COMMITTEE WHERE IT WILL BE MERGED WITH THE MARKUP OF THE CONSERVATION AND RENEWABLE ENERGY PROGRAMS BY THE SUBCOMMITTEE ON ENVIRONMENT. THE TENTATIVE SCHEDULE WILL BE TO HAVE A FULL COMMITTEE MARKUP ON THE COMBINED PACKAGE ON MAY 8, 1991.

BEFORE I RECOGNIZE OUR RANKING REPUBLICAN MEMBER, SID MORRISON, FOR HIS OPENING REMARKS, I WANT TO CLARIFY OUR PROCEDURES TODAY. THE PACKAGE BEFORE YOU TODAY CONTAINS AN AGENDA, A DRAFT BILL, WHICH WE WILL USE AS THE MARKUP VEHICLE, A DRAFT REPORT, AND A SUMMARY BUDGET TABLE. OUR STAFF DIRECTOR, FRANK MURRAY WILL GIVE A BRIEF DESCRIPTION OF THE PROVISIONS OF THE BILL AND THEN THE BILL WILL BE OPEN FOR AMENDMENT. I WILL BE OFFERING AN AMENDMENT EN BLOC. THE AMENDMENT WILL CORRECT SOME DRAFTING ERRORS IN THE MARKUP VEHICLE SENT TO YOU PREVIOUSLY. MOST OF THE AMENDMENTS ARE TECHNICAL AND CONFORMING IN NATURE, HOWEVER I WILL DISCUSS FOUR SEPARATE ADDITIONAL ITEMS INLCUDED IN THE AMENDMENT AT THE APPROPRIATE TIME.

FOLLOWING MY AMENDMENTS, OTHER MEMBERS MAY OFFER AMENDMENTS TO THE BILL. WE WILL THEN DISCUSS THE REPORT AND ANY NEW LANGUAGE OFFERED BY MEMBERS.

I WANT TO NOW RECOGNIZE THE HONORABLE SID MORRISON FOR HIS OPENING STATEMENT.

WOULD OTHER MEMBERS CARE TO MAKE AN OPENING STATEMENT?

I would like to now recognize my good friend, the Honorable Sid Morrison, for his opening statement.

Mr. MORRISON. Thank you, Madam Chairman. I have an opening statement that I will present for the record. I wanted to mention only a couple of points.

To repeat your optimism, it has been a long time since we have done the authorizing work that leads to a budget vehicle. Again, with your leadership, and that of our new Chairman, Mr. Brown, we feel that we will be successful.

I would also like to thank you and your staff for a marvelous level of cooperation. As you have indicated, there is not enough in the funding arena to go around for all the things we would measure as priorities on this subcommittee. But the team has done a very good job. I thank you and compliment everyone on the smooth working relations.

There is a concern that has been raised by Mr. Walker, the ranking member of the full Committee, of the SP100 program and that some arrangement has been discussed with Mr. Brown to accommodate some of these concerns in full Committee. I know we will be interested in ironing that out.

I want to express a personal thanks for the work on the Fast Flux Test Facility. It is our hope that this is the last year, not that the reactor will be closing—but that is one of the options—but that this is the last year for the marketing effort that is underway, and also that you've included in the authorizing legislation the commercialization of FFTF. We hope that is a success to keep the newest—and some of us think the best—of the reactors in the research fleet going, but that from now on it would be with international cooperation.

Also, I was called this morning, Madam Chairman, by the Department of Energy concerned about the cuts in the first-of-a-kind engineering. I told them that I would not choose to disrupt the marvelous work that has been done in cooperation here with the subcommittee, but I reserve the opportunity to see if we could build in more of their concerns between now and the full Committee markup.

[The prepared statement of Mr. Morrison follows:]

OPENING STATEMENT

HONORABLE SID MORRISON

SUBCOMMITTEE ON ENERGY - MARKUP

ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT AUTHORIZATION

FOR FISCAL YEAR 1992 AND FISCAL YEAR 1993

THANK YOU MADAM CHAIRMAN. I TOO AM PARTICULARLY PLEASED TO WELCOME THE SUBCOMMITTEE MARKUP OF AN ENERGY AUTHORIZATION BILL FOR ENERGY RESEARCH AND DEVELOPMENT. IT HAS BEEN A LONG TIME.

I WOULD ALSO LIKE TO THANK YOU AND YOUR STAFF FOR THE COOPERATION YOU HAVE SHOWN FROM THE VERY BEGINNING OF OUR DELIBERATIONS. YOUR PERSONAL COMMITMENT TO SEVERAL PRIORITIES, ALSO IMPORTANT TO ME AND THE REPUBLICANS ON THE SUBCOMMITTEE, MADE FOR SMOOTH WORKINGS AMONG THE MEMBERS AND STAFF.

WE WERE NOT ABLE TO AGREE ON EVERY DETAIL OF

THIS DRAFT BILL. THERE WERE SOME ISSUES RAISED ABOUT REDUCTIONS IN THE SPACE RELATED PROGRAMS, PARTICULARLY THE SP-100 PROGRAM. HOWEVER IT IS MY UNDERSTANDING THAT AFTER SPEAKING WITH MR. WALKER, RANKING MEMBER OF THE SCIENCE COMMITTEE, THAT SOME ARRANGEMENT HAD BEEN DISCUSSED WITH MR. BROWN, CHAIRMAN OF THE SCIENCE COMMITTEE, TO ACCOMMODATE SOME OF THESE CONCERNS IN FULL COMMITTEE.

IN ADDITION TO ITEMS YOU MENTIONED IN YOUR OPENING STATEMENT WHICH ARE INCLUDED IN THE DRAFT BILL I WOULD LIKE TO MENTION A FEW. FIRST OF ALL YOUR COMMITMENT TO THE FAST FLUX TEST FACILITY WAS INDEED APPRECIATED. THE SUBCOMMITTEE IS AUTHORIZING FUNDING FOR THE FFTF FOR ONE MORE YEAR TO ENABLE THE GOVERNOR OF THE STATE OF WASHINGTON TO FIND INTERNATIONAL PARTNERS TO HELP OPERATE THE FACILITY, WHICH IS BY THE WAY THE NEWEST AND MOST ADVANCED REACTOR OF ITS TYPE IN THE UNITED STATES.

THIS ONE YEAR TRANSITION IS INDEED APPRECIATED BY THE MANY FOLKS WHO SEE THE FFTF AS A SCIENCE AND ENERGY PROJECT WORTH FUNDING FOR THE FUTURE RESEARCH AND TECHNOLOGY POTENTIAL IT OFFERS.

THE BILL ALSO CONTAINS PROVISIONS TO ALLOW COMMERCIALIZATION OF THE FFTF WHICH WILL ALLOW THE INTERNATIONAL COOPERATION ENVISIONED BY THE GOVERNOR OF WASHINGTON STATE. THIS TYPE OF ACTIVITY AT FACILITIES SUCH AS FFTF WILL LEAD TO MUCH GREATER INTERNATIONAL COOPERATION IN THE AREAS OF ENERGY RESEARCH AND DEVELOPMENT AND SCIENCE EDUCATION.

AGAIN LET ME THANK YOU MADAM CHAIRMAN FOR A JOB APPRECIATED AND WELL DONE.

Mrs. **Lloyd.** I certainly concur with your sentiments, Mr. Morrison. I hope that between now and full Committee markup where there are diversities of opinion that we can reach a consensus. Certainly, the Chair will be working with you in that regard.

Mr. Fawell.

Mr. **Fawell.** Madam Chairman, I had a prepared statement. I won't read the same in order to be able to conserve time. I just congratulate you in regard to some very fine leadership in bringing this authorization bill to the subcommittee.

[The prepared opening statement of Mr. Fawell follows:]

ENERGY SUBCOMMITTEE

APRIL 25, 1991

Rep Harris Fawell (IL-13)

MADAME CHAIRMAN, I AM PLEASED WITH THE WORK THE SUBCOMMITTEE HAS DONE TO CREATE A BILL WHICH WILL IMPROVE OUR NATION'S ENERGY SECURITY THROUGH ITS EMPHASIS ON ALTERNATIVE ENERGY SOURCES, SUCH AS NUCLEAR AND FUSION ENERGY. THE BILL ALSO CALLS FOR INCREASED EMPHASIS ON NUCLEAR ENGINEERING EDUCATION, WHICH WILL PREPARE THE NEXT GENERATION OF SCIENTISTS TO MEET THE ENERGY TECHNOLOGY CHALLENGES OF THE FUTURE.

THE BILL ENHANCES OUR NATIONAL COMPETITIVENESS THROUGH A FORWARD-LOOKING APPROACH AIMED AT TIMELY COMPLETION OF THE NATIONAL USER FACILITIES SUCH AS THE ADVANCED PHOTON SOURCE. WHEN COMPLETED IN 1995, THE APS WILL BE THE SOURCE OF THE WORLD'S BRIGHTEST X-RAYS, PROVIDING NEW INSIGHT INTO MATERIALS SCIENCES, BIOLOGY, MEDICINE, BIOTECHNOLOGY, CHEMISTRY, PHYSICS, AND THE GEOSCIENCES. THE BILL ALSO CALLS FOR A RATIONAL APPROACH TOWARD CONSTRUCTION OF NEW FACILITIES WHICH WILL ALLOW FOR FULL CONSIDERATION [illegible] TO EACH FACILITY BY THE CONGRESS.

BY CONTINUING RESEARCH INTO ADVANCED REACTOR DESIGNS SUCH AS THE MODULAR HIGH TEMPERATURE GAS COOLED REACTOR AND THE ADVANCED LIQUID METAL REACTOR, OUR NATION CAN MEET ITS ELECTRICITY NEEDS OF THE FUTURE. DESIGNATED AS THE "CENTERPIECE" OF THE DEPARTMENT OF ENERGY'S ADVANCED REACTOR R&D PROGRAM, THE INTEGRAL FAST REACTOR IS A REVOLUTIONARY REACTOR CONCEPT WHICH NOT ONLY HAS INHERENT SAFETY FEATURES, BUT IS CAPABLE OF RECYCLING LONG-LIVED RADIOACTIVE WASTES.

FINALLY, I AM PLEASED THAT THE SUBCOMMITTEE HAS CALLED FOR A NEW CIVILIAN RADIOACTIVE WASTE RESEARCH AND DEVELOPMENT INITIATIVE. THROUGH A BALANCED PROGRAM IN NUCLEAR WASTE MITIGATION, OUR NATION CAN ENSURE A PLACE FOR NUCLEAR ENERGY IN THE FUTURE.

Mrs. LLOYD. Thank you very much.

Mr. Wolpe.

Mr. WOLPE. Thank you very much, Madam Chairman.

I first want to begin by commending you for your leadership of the subcommittee. You are a very forceful protective advocate for your point of view. While we have disagreed on policy issues over the years, you have always treated our disagreements with great fairness and with courtesy. I do appreciate that and look forward to working with you for many years to come.

Having said that, I must once again express my opposition to the legislation before the subcommittee this morning. I will not take the subcommittee's time by trying to amend this bill at this time. I can certainly count the votes. I would, however, like to indicate my intention to offer such amendments when this legislation is considered before the full Committee. I will also refrain from describing the reasons for my opposition in much detail. I intend to file dissenting views that will fully lay out my concerns.

I would, however, like to just take a brief moment to quickly mention my primary reason for opposing this bill. Last fall's bipartisan budget summit agreement has created some very fierce competition for domestic discretionary spending. I believe we must therefore begin to adopt objective criteria to effectively target R&D investments so as to achieve well-defined national goals. In my opinion, the allocations within this bill simply fail to meet this critical test.

I also have concerns regarding specific items in this bill, such as the AVLIS initiative, as well as a general concern about the overall funding level. But I have made my views known on these matters during this year's hearing process, and I won't take the subcommittee's time to raise those issues at this point.

Thank you very much.

[The prepared opening statement of Mr. Wolpe follows:]

STATEMENT OF REP. HOWARD WOLPE

April 25, 1991

Thank you, Madame Chairwoman. I would like to begin by commending you for your leadership of this subcommittee. You are a forceful and effective advocate for your point of view. While we have disagreed on policy issues over the years, ~~those disagreements have never become personal~~ you have always treated our disagreements with fairness and courtesy. I look forward to working with you for many years to come.

Having said that, I must once again express my opposition to legislation before this subcommittee. I will not take the subcommittee's time by trying to amend this bill at this time. I can count the votes. I would, however, like to indicate my intention to offer such amendments when this legislation is considered before the full Committee.

I will also refrain from describing the reasons for my opposition in great detail. I intend to file dissenting views that will fully lay out my concerns. I would, however, like to take a moment to quickly mention my primary reason for opposing this bill.

Last fall's bipartisan budget summit agreement has created fierce competition for domestic discretionary spending. I believe that we must therefore begin to adopt objective criteria to effectively target R&D investments so as to achieve well-defined national goals. In my opinion, this bill fails to meet this critical test.

I also have concerns regarding specific items in this bill--such as AVLIS--as well as a general concern about the overall funding level in this bill. But I have made my views known on these matters during this year's hearing process. I won't take the Subcommittee's time to raise those issues at this time.

Thank you, Madame Chairwoman.

Mrs. LLOYD. Mr. Smith.

Mr. SMITH. I want to say, too, how much I appreciate your hard work on this legislation, as well as that of our ranking Republican and my colleague, Mr. Morrison.

This year's bill is especially important because of the recognition it gives to the Department of Energy's enhanced oil recovery efforts. Twice as much oil and gas remain in the ground than all we have produced in history. We just have to learn how to extract it, which is the goal of the enhanced oil recovery research.

We also must begin to slow down the alarming rate of well abandonments. In 1990, roughly 75 percent of U.S. producing oil wells were classified as stripper wells, producing less than 10 barrels per day. If we do not develop technologies quickly to preserve access to these wells, we risk losing two-thirds of our remaining oil in place.

That is why I strongly praise the subcommittee's decision to fully fund the Department's enhanced oil recovery program.

Another program that is of long-term importance to the United States is the space exploration initiative. In the President's request, $30 million was asked for the Department of Energy for SEI. Although the subcommittee authorized only $5 million this activity, I understand that there are efforts on both sides to reinstate full funding for this activity during full Committee consideration. I am a proponent for full funding of this account.

The Department of Energy controls our national laboratories that have great potential to contribute to the overall goals of SEI. Indeed, the President's $30 million request was for initiation of specific technology development that is crucial to any long-term manned space exploration effort.

Our national laboratories represent a magnificent talent pool that can bring a great deal of intellectual firepower to bear on the challengers of space exploration.

I strongly support the President's request, and look forward to full restoration of that funding as well.

Thank you, Madam Chairman.

[The prepared opening statement of Mr. Smith follows:]

OPENING STATEMENT BY REP. LAMAR SMITH

Thank you, Madam Chairman. I want to say how much I appreciate your hard work on this legislation, as well as that of our Ranking Republican, Mr. Morrison.

This year's bill is especially important because of the recognition it gives to the Department of Energy's enhanced oil recovery efforts.

Twice as much oil and gas remain in the ground than all we have produced in history – we just have to learn how to extract it, which is the goal of the enhanced oil recovery research.

We also must begin to slow down the alarming rate of well abandonments. In 1990, roughly 75 percent of U.S. producing oil wells were classified as stripper wells, producing less than 10 barrels per day.

If we do not develop technologies quickly to preserve access to these wells, we risk losing two-thirds of our remaining oil in place.

This is why I strongly praise the Subcommittee's decision to fully fund the Department's enhanced oil recovery program.

Another program that is of long-term importance to the United States is the Space Exploration Initiative.

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The Department of Energy controls our National Laboratories, that have great potential to contribute to the overall goals of SEI.

Indeed, the President's $30 million request was for initiation of specific technology development that is crucial to any long-term manned space exploration effort.

Our National Laboratories represent a magnificent talent pool that can bring a great deal of "intellectual firepower" to bear on the challenges of space exploration.

I strongly support the President's request, and look forward to full restoration of this funding.

Mrs. Lloyd. Thank you very much.

Mr. Cramer.

Mr. Cramer. Good morning, Madam Chairman. I am submitting a statement for the record. I appreciate your hearing this morning, and I thank you.

[The prepared opening statement of Mr. Cramer follows:]

OPENING STATEMENT
DOE SUBCOMMITTEE MARKUP
APRIL 25, 1991

THANK YOU MADAME CHAIRMAN.

I AM VERY INTERESTED IN PROGRAMS THAT HELP FACILITATE SCIENCE, MATHEMATICS AND ENGINEERING EDUCATION, PARTICULARLY THOSE THAT ASSIST OUR HISTORICALLY BLACK COLLEGES AND UNIVERSITIES. HISTORICALLY BLACK COLLEGES AND UNIVERSITIES NEED THE FACILITIES AND THE RESOURCES TO HELP CORRECT THE PROBLEMS WE ARE FACING BY NOT PRODUCING ENOUGH MINORITY SCIENTISTS AND ENGINEERS.

THE REPORT LANGUAGE, WHICH IS A RECOGNITION OF THE PROBLEM, IS A GOOD FIRST STEP IN HELPING TO ALLEVIATE THIS SITUATION. OUR NEXT ACTION SHOULD BE ONE OF A FINANCIAL NATURE TO ASSIST OUR NATION'S HISTORICALLY BLACK COLLEGES TO ESTABLISH THE PROGRAMS AND THE FACILITIES NECESSARY TO ACHIEVE THIS GOAL.

I WANT TO THANK YOU MADAME CHAIRMAN FOR YOUR INTEREST IN THIS VITAL AREA AND FOR YOUR CONTINUED LEADERSHIP IN REACHING THESE GOALS. I LOOK FORWARD TO WORKING WITH YOU IN THE COMING YEARS.

THANK YOU MADAME CHAIRMAN.

Mrs. LLOYD. Thank you very much.

I do ask unanimous consent that the draft bill be before the members, which reflects the subcommittee's actions on the Energy Technology Research and Development Authorization Act of 1992 and 1993 for markup purposes.

[A copy of the draft bill plus section-by-section analysis, and summary of table follows:]

(Original signature of Member)

[redacted]

102d CONGRESS
1st SESSION

H.R. ______

Insert title here ☞

To authorize appropriations for research and development and demonstration activities of the Department of Energy for fiscal years 1992 and 1993, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

______, 19__

Insert sponsor's name here ☞

Mrs. LLOYD (for herself and Mr. Morrison) introduced the following bill; which was referred to the Committee on ______

A BILL

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ``Energy Technology Research and Development Authorization Act of 1991''.

SEC. 2. FINDINGS.

The Congress finds that--

(1) the development of new energy technologies is a necessary step in reducing oil imports and providing for our Nation's energy needs in the 21st century;

(2) the development of efficient, economic, safe, and environmentally acceptable energy technologies is a necessary part of an effective National Energy Strategy;

(3) technological advances in the recovery and use of our fossil fuel resources will provide time for an orderly transition to other energy sources while at the same time reducing our vulnerability to supply disruptions, price escalations, and the environmental side effects of fossil fuel use; and

(4) technology development occurs over a time span that is often measured in years or even decades, therefore, commitments to new energy technology development must be consistent with those time requirements and cannot be made on a year-to-year basis.

SEC. 3. DEFINITIONS.

For purposes of this Act--

(1) the term ``major construction project'' means a project whose construction costs are estimated to exceed $100,000,000 over the life of the project;

(2) the term ``Secretary'' means the Secretary of Energy; and

(3) the term ``substantial construction project'' means a project whose construction costs are estimated to exceed $10,000,000, but not to exceed $100,000,000, over the life of the project;

SEC. 4. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary the following amounts:

(1) Supporting Research and Technical Analysis--

(A) Basic Energy Sciences Program--

(i) $714,700,000 for fiscal year 1992, of which $6,300,000 shall be for completion of construction of the Advanced Light Source and $90,400,000 shall be for construction of the Advanced Photon Source;

(ii) $836,500,000 for operating, capital equipment, and construction for fiscal year 1993, of which $437,600,000 shall be for research activities, $196,000,000 shall be for the operation of user facilities, $112,500,000 shall be for construction of the Advanced Photon

Source, and $38,900,000 shall be for construction of the Advanced Neutron Source;

(iii) $93,000,000 for fiscal year 1994 shall be for construction of the Advanced Photon Source; and

(iv) $45,000,000 for fiscal year 1995 shall be for completion of the construction of the Advanced Photon Source;

(B) Energy Research Analysis Program, $4,000,000 for fiscal year 1992, and $4,200,000 for fiscal year 1993;

(C) Multiprogram Energy Laboratories Facilities Support program, $23,900,000 for fiscal year 1992, and $24,900,000 for fiscal year 1993;

(D) University and Science Education, $57,500,000 for fiscal year 1992, and $72,900,000 for fiscal year 1993; and

(E) Advisory and Oversight Program Direction and Policy Management for Energy Research activities, $10,100,000 for fiscal year 1992, and $10,500,000 for fiscal year 1993.

(2) Nuclear Energy--

(A) Nuclear Energy Research and Development Program, $391,000,000 for fiscal year 1992, and $420,000,000 for fiscal year 1993, including--

(i) Certification of Light Water Reactor Designs, $44,500,000, for fiscal year 1992, of which $2,000,000 shall be for first-of-a-kind engineering for initiating the first standardized commercial nuclear power plant, and $62,500,000 for fiscal year 1993, of which $20,000,000 shall be for first-of-a-kind engineering for initiating the first standardized commercial nuclear power plant;

(ii) Advanced Reactor Research and Development, $60,500,000 for fiscal year 1992, and $73,000,000 for fiscal year 1993;

(iii) Space Reactor Power Systems, $36,000,000 for fiscal year 1992, and $36,500,000 for fiscal year 1993;

(iv) Advanced Radioisotope Power, $56,000,000 for fiscal year 1992, and $58,000,000 for fiscal year 1993;

(v) Space Exploration Initiative, $5,000,000 for fiscal year 1992, and $5,000,000 for fiscal year 1993;

(vi) Facilities Support, including operations, capital equipment, and general plant construction, $178,800,000 for fiscal year 1992, of which $79,000,000 shall be for the Fast Flux

Test Facility, and $168,800,000 for fiscal year 1993, of which $69,000,000 shall be for the Fast Flux Test Facility; and

(vii) Program Direction, Nuclear Energy, $10,200,000 for fiscal year 1992, and $16,200,000 for fiscal year 1993; and

(B) For developing and conducting an integrated research and development program to explore new technologies for reducing, treating, transmuting, separating, recycling, storing, or otherwise mitigating hazards associated with high level radioactive waste and spent fuel from nuclear reactors, $8,000,000 for fiscal year 1992, and $8,320,000 for fiscal year 1993.

(3) Fusion Energy Research and Development--

(A) Magnetic Fusion Energy Research, including operating activities, program direction, capital equipment, and construction activity--

(i) $328,900,000 for fiscal year 1992, of which--

(I) $30,000,000 shall be for preconstruction activities of the Burning Plasma Experiment facility; and

(II) $41,800,000 shall be for the Engineering Design Activity of the

International Thermonuclear Engineering Reactor; and

(ii) $387,000,000 for fiscal year 1993, of which $35,400,000 shall be for construction of the Burning Plasma Experiment facility; and

(B) Inertial Confinement Fusion Program, $8,200,000 for fiscal year 1992, and $14,000,000 for fiscal year 1993.

(4) Atomic Vapor Laser Isotope Separation Program--

(A) $228,600,000 for fiscal year 1992, of which--

(i) $219,300,000 shall be for operations, including $20,000,000 for procurement of a commercial deployment contractor and a predeployment assessment of the demonstration of Atomic Vapor Laser Isotope Separation technology and the preparation of a report to the Congress, to be submitted within 90 days after completion of such demonstration, on the economic market, financing, and risk assessment for commercial deployment of such technology;

(ii) $6,100,000 shall be for capital equipment; and

(iii) $3,200,000 shall be for construction; and

(B) $225,800,000 for fiscal year 1993.

(5) Environmental Restoration and Waste Management Program, for corrective activities, environmental restoration, waste management, and related technology development for civilian programs and activities of the Department of Energy, $523,500,000 for fiscal year 1992, and $594,200,000 for fiscal year 1993.

(6) Fossil energy--

(A) $471,000,000 for fiscal year 1992, of which--

(i) $206,000,000 shall be for Basic and Supporting Research, including Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification, and Surface Coal Gasification;

(ii) $89,000,000 shall be for Advanced Technology Development, including $48,000,000 for Fuel Cells, and $41,000,000 for Magnetohydrodynamics;

(iii) $70,000,000 shall be for Petroleum;

(iv) $23,000,000 shall be for Natural Gas;

(v) $6,000,000 shall be for Cooperative Research and Development; and

(vi) $77,000,000 shall be for Supporting Activities, including Program Direction and Management Support, Environmental Restoration, and Plant and Capital Equipment; and

(B) $507,000,000 for fiscal year 1993, of which--

(i) $214,000,000 shall be for Basic and Supporting Research, including Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification, and Surface Coal Gasification;

(ii) $88,000,000 shall be for Advanced Technology Development, including $60,000,000 for Fuel Cells, and $28,000,000 for Magnetohydrodynamics;

(iii) $90,000,000 shall be for Petroleum;

(iv) $26,000,000 shall be for Natural Gas;

(v) $7,000,000 shall be for Cooperative Research and Development; and

(vi) $82,000,000 shall be for Supporting Activities, including Program Direction and Management Support, Environmental Restoration, and Plant and Capital Equipment.

SEC. 5. MAJOR CONSTRUCTION POLICY.

(a) STATEMENT OF POLICY.--(1) It shall be the policy of the United States, with respect to substantial construction projects of the Department of Energy in civilian energy research and development areas, to authorize appropriations for the life of such substantial construction projects when the projects are initially authorized.

(2) It shall be the policy of the United States, with respect to major construction projects of the Department of Energy in civilian energy research and development areas, to authorize appropriations for the life of such major construction projects when the preliminary design phase is completed and appropriate information is provided to the Congress with respect to anticipated costs and schedules.

(b) REPORT TO CONGRESS.--The Secretary shall, after completion of the preliminary design phase of a major construction project, submit to the Congress a report containing--

(1) an estimate of the total cost of construction of the facility;

(2) an estimate of the time required to complete construction;

(3) an estimate of the annual operating costs of the facility;

(4) the intended useful operating life of the facility; and

(5) an identification of any existing facilities to be closed as a result of the operation of the facility.

SEC. 6. ADVANCED NEUTRON SOURCE AND BURNING PLASMA EXPERIMENT MAJOR CONSTRUCTION REPORTS.

The Secretary shall, within 120 days after the date of completion of the preliminary design phase of the Advanced Neutron Source major construction project, and of the Burning Plasma Experiment major construction project, provide the Congress with information on the anticipated cost and schedule with respect to each such project, to enable the Congress to consider authorization of each such project in its entirety as a major construction project.

SEC. 7. ATOMIC VAPOR LASER ISOTOPE SEPARATION.

(a) DEPLOYMENT CONTRACTOR.--The Secretary shall proceed expeditiously to procure a deployment contractor for the commercialization of the Atomic Vapor Laser Isotope Separation technology.

(b) IDENTIFICATION OF ALTERNATIVE APPLICATIONS.--The Secretary shall authorize the University of California and Martin Marietta Energy Systems, Inc. to enter into cooperative research and development agreements with private sector entities to identify and develop non-uranium enrichment applications of the Atomic Vapor Laser Isotope Separation technologies.

SEC. 8. STANDARDIZED COMMERCIAL NUCLEAR POWER PLANT.

(a) AWARD OF CONTRACT.--The Secretary shall award a contract for further design and engineering with respect to a standardized commercial nuclear power plant design that has been certified by the Nuclear Regulatory Commission.

(b) SELECTION CRITERIA.--The Secretary shall award the contract under subsection (a) to an entity that certifies to the satisfaction of the Secretary that--

(1) the plant will be constructed in the United States;

(2) at least 75 percent of all design, engineering, manufacture, and construction activities in connection with the plant shall be performed in the United States;

(3) the entity is a bona fide entity normally engaged in the design, engineering, manufacture, and construction of nuclear reactors;

(4) the entity has entered into a binding agreement for construction of a nuclear power plant with a utility or private entity whose primary purpose is the production of electrical power for public consumption; and

(5) the entity has the financial resources necessary, and fully intends, to pursue the design, engineering, manufacture, and construction of a full-scale nuclear power plant of at least 600 MWe in size through completion of construction and into operation.

(c) FUNDING.--The project described in this section shall receive at least 50 percent of its funding from non-Federal sources. Federal funding for such project shall not exceed $20,000,000 for each fiscal year, and the total of Federal funding over the course of such project shall not exceed

$60,000,000.

SEC. 9. HISTORICALLY BLACK COLLEGES AND UNIVERSITIES.

The Secretary shall, within 6 months after the date of enactment of this Act, submit to the Congress a report outlining plans for increasing the participation of historically black colleges and universities in the Basic Energy Science programs of the Department of Energy.

SEC. 10. RESEARCH REACTOR USER COMPLEX.

(a) PURPOSE.--The purpose of this section is to establish the Fast Flux Test Facility as a multi-mission center for the purpose of conducting research and development on isotopes and energy, to be operated by the Department of Energy in partnership with international and domestic user organizations.

(b) ESTABLISMENT.--Not later than 90 days after the date of enactment of this Act, the Secretary shall establish a research, development, and production center at the Hanford Reservation in Richland, Washington, to be known as the ``Research Reactor User Complex'' (hereafter in this section referred to as the ``RRC'').

(c) AGREEMENTS; AUTHORIZED USES.--In establishing the RRC, the Secretary shall provide that the Department of Energy, and any contractors under contract with the Department of Energy to operate the RRC, may enter into agreements with non-Federal entities (including foreign governments and foreign entities) or a consortium of such entities to use the RRC for any of the following purposes:

(1) The production of industrial and medical isotopes for use or sale, or both, by the non-Federal entities who have entered into the agreement.

(2) Irradiation services to support research or commercial objectives, or both.

(3) The production of steam to be used or sold, or both, by the non-Federal entities who have entered into the agreement.

(d) CHARGES.--The Secretary may assess such charges from non-Federal entities under an agreement entered into pursuant to subsection (c) as the Secretary determines may be necessary or appropriate to implement the purpose of this section.

(e) PERIOD OF AGREEMENT.--The Secretary shall not enter into an agreement pursuant to subsection (c) for a period of time exceeding 25 years.

(f) TERMINATION PROVISIONS.--(1) Under an agreement entered into pursuant to subsection (c), the Secretary may include a termination provision that requires the Department of Energy to pay for the unamortized balance of any special facilities acquired or constructed by the non-Federal entities who have entered into the agreement if--

(A) the RRC is shut down for lack of Federal appropriations; and

(B) the acquisition or construction of the special facilities constitutes a significant portion of the investment by the non-Federal entities under the agreement.

(2) A termination provision described in paragraph (1) may authorize the use, for the purpose of paying such unamortized balance and any other costs resulting from termination, of any Federal funds available for operating expenses pursuant to subsection (j)(2).

(3) For purposes of this subsection, the term ``special facilities'' means any depreciable buildings, structures, utilities, machinery, equipment, materials, or services not made available to non-Federal entities by the Department of Energy.

(g) OTHER AGREEMENT PROVISIONS.--Under an agreement entered into pursuant to subsection (c), the Secretary may--

(1) make available to non-Federal entities facilities, equipment, utility services, fire protection, and other similar services;

(2) lease real or personal property to non-Federal entities to carry out the purpose of this section;

(3) include an appropriate indemnification pursuant to section 170 d. of the Atomic Energy Act of 1954 (42 U.S.C. 2210); and

(4) include such other terms and conditions as the Secretary determines will implement the purpose of this section.

(h) COMPETITIVE PROCEDURES.--In entering into a contract with a non-Federal entity pursuant to subsection (c), the Secretary may use procedures other than competitive procedures as described in section 303 of the Federal Property and Administrative Services Act of 1949 (41 U.S.C. 253).

(i) PROVISIONS RELATING TO DEPARTMENT OF ENERGY CONTRACTOR.--A contractor under contract with the Department of Energy to operate the RRC shall--

(1) maintain and operate the Fast Flux Text Facility under contract with and for the account of the Department of Energy pursuant to section 110 of the Atomic Energy Act of 1954 (42 U.S.C. 2140);

(2) ensure that all experiments meet applicable safety requirements and acceptable criteria; and

(3) provide necessary support services to the non-Federal entities that have entered into agreements pursuant to subsection (c).

(j) RRC FUND.--(1) There is established in the Treasury of the United States a separate fund to be known as the ``RRC Fund''. The RRC Fund shall consist of all amounts received by the Secretary from charges assessed under subsection (d).

(2) Subject to appropriations, the Secretary may make expenditures from the RRC Fund each fiscal year to offset the cost of operating the RRC in such fiscal year. Amounts in the RRC Fund not needed for operations shall be invested in United States securities, the proceeds of which shall accrue to the RRC Fund.

SEC. 11. COST SHARING GUIDELINES.

The Secretary shall conduct a study of the appropriateness of cost sharing requirements for fossil research and development projects of the Department of Energy, taking into account the type of project and costs required for completion. Within 6 months after the date of enactment of this Act, the Secretary shall submit to the Congress a report containing the results of such study, along with proposed guidelines for cost sharing with respect to such projects, including provisions regarding the use of data, rights of parties, and ownership of the research results or technologies developed.

SEC. 12. ANNUAL BUDGET SUBMISSION.

The Secretary shall annually submit to Congress, along with the President's budget request, a 3-year budget estimate for the civilian research and development programs of the Department of Energy, including funding estimates for each major account and new initiative.

SEC. 13. AUTHORIZATION RESTRICTION.

Notwithstanding any other provision of this Act--

(1) no amount appropriated pursuant to this Act may be used for any program for which funding was requested in an annual budget request of the President but for which the Congress declined to authorize funding; and

(2) no amount appropriated pursuant to this Act may be used for any program in excess of the amount authorized for that program under this Act.

-DRAFT-

ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT AUTHORIZATION ACT FOR FISCAL YEAR 1992 AND FISCAL YEAR 1993 FOR THE DEPARTMENT OF ENERGY CIVILIAN RESEARCH AND DEVELOPMENT PROGRAMS

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I. INTRODUCTION

The objective of the Energy Technology Research and Development Act is to provide funds for Fiscal Year (FY) 1992 and FY 1993 for the conduct of research and development of energy technology programs. This authorization act is limited to research and development funded through the Department of Energy (DOE) and within the sole jurisdiction of the Subcommittee on Energy.

In addition to the operating, equipment, and General Plant Projects (GPP) and minor construction funds, this act also addresses the authorization of substantial construction projects and major construction projects, and as appropriate, stipulates the requirements placed upon the DOE to submit future construction projects for authorization approval.

Finally, this act addresses a number of policy issues related to the conduct and oversight of energy research and development programs. These include the authorization of construction projects, budget submissions and cost sharing as well as other issues. As appropriate, the act requires the DOE to provide reports to the Congress.

II. FINDINGS

The Subcommittee finds that:

1. The development of new energy technologies is a necessary step in reducing oil imports and providing for our Nation's energy needs in the 21st Century.

2. The development of efficient, economic, safe, and environmentally acceptable energy technologies is a necessary part of an effective National Energy Strategy.

3. Technological advances in the recovery and use of our fossil fuel resources will provide time for an orderly transition to other energy sources while at the same time reducing our vulnerability to supply disruptions, price escalations and the environmental side effects of fossil fuel use.

4. Technology development occurs over a time span that is often measured in years or even decades; therefore, commitments to new energy technology development must be consistent with these time requirements and cannot be made on a year to year basis.

III. HEARINGS

The Subcommittee on Energy held hearings on the Fiscal Year 1992 DOE authorization request for the following research and development programs: Fossil Energy; Nuclear Energy; Fusion Energy; Oil & Gas; Basic Energy Sciences; and the Atomic Vapor Laser Isotope Separation Research and Development Program. The hearings were held on March 5, 6, 13, 14, 19, and April 10, 1991.

Department of Energy officials who testified included: Honorable Robert Gentile, Assistant Secretary for Fossil Energy; Honorable William H. Young, Assistant Secretary for Nuclear Energy; and Dr. James Decker, Director, Office of Energy Research.

In addition, the following citizens testified: Mr. Frank Burke, National Coal Association; Mr. Gary Styles, Manager, Advanced Fuels Utilization, Southern Company Services; Mr. Lawrence J. Wisdom, Vice President, HRI, Inc.; Mr. Donald Peebles, President and Chief Executive Officer, Montana Technology Companies; Mr. Frank Schora, President and Chief Executive Officer, M-C Power Corporation; Dr. Jack Sanderson, Asea Brown Boveri Incorporated; Mr. Walt Dollard, Westinghouse Electric Corporation; Mr. Arnold Aldrich, Associate Administrator, National Aeronautics and Space Administration; Dr. Shelby T. Brewer, President, Nuclear Business, Combustion Engineering; Mr. Nathanial Woodson, Vice President, Energy Systems, Westinghouse Hanford Company; Dr. Bertram Wolfe, Vice President, General Electric; Mr. Patrick McDonald, Executive Vice President, Southern Nuclear Operating Company; Dr. Charles Till, Associate Director, Argonne National Laboratory; Mr. Linden Blue, Vice Chairman of the Board, GA Technologies; Dr. Alex Zucker, Associate Director, Nuclear Technology, Oak Ridge National Laboratory; Mr. Jeff Breckel, Special Assistant to the Governor, State of Washington; Mr. Roger Nichols, Deputy General Manager, Government Operations, Westinghouse Hanford Company; Dr. Ronald C. Davidson, Director, Princeton Plasma Physics Laboratory; Dr. Ron Parker, Director, Fusion Laboratory, Massachusetts Institute of Technology; Dr. Roger Bangerter, Group Leader, Heavy Ion Fusion Accelerator Research Division, Lawrence Berkeley National Laboratory; Dr. David Overskei, Senior Vice President, Fusion Division, GA Technologies; Dr. Harold Forsen, Vice President, Research and Development, Bechtel Power Corporation; Dr. Stephen O. Dean, President, Fusion Power Associates; Dr. Alex Glass, Associate Director for Programs, Lawrence Livermore National Laboratory; Mr. George E. Strang, Vice President for Engineering and Operating Support, Southern California Gas; Mr. David O. Webb, Vice President, Gas Research Institute; Dr. Bernard Lee, President, Institute of Gas Technology; Dr. Thomas A. Hyde, Chairman and Professor of Engineering, University of Texas; Mr. James Deterding, Vice President and Director, National Institute for Petroleum and Energy Research; Dr. Frank Derbyshire, Director, Center for Applied Energy Research, University of Kentucky; Dr. Marcus H. Voth, Director, Radiation Science & Engineering Center, Pennsylvania State University; Dr. Barclay G. Jones, Professor and Head, Department of Nuclear Engineering, University of Illinois; Dr. Frank Y. Fradin, Associate Laboratory Director, Physical Research, Argonne National Laboratory; Dr. Martin Blume, Deputy Director, Brookhaven National Laboratory; Dr. Michael Knotek, Senior Science Director, Pacific Northwest Laboratory; Dr. Jay N. Marx, Director, Advanced Light Source, Lawrence Berkeley Laboratory; Dr. David E. Moncton, Associate Laboratory Director, Advanced Photon Source, Argonne National Laboratory; Dr. B.R. Appleton, Associate Director, Physical Sciences and Advanced Materials, Oak Ridge National Laboratory; Mr. Robert M. Bernero, Director, Office of Nuclear Material Safety and Safeguards, Nuclear Regulatory Commission; Mr. Victor S. Rezendes, Director of Energy Affairs, General Accounting Office; Dr. James I. Davis, Associate Director for Lasers, Lawrence Livermore National Laboratory; Dr. Robert Merriman, Vice President, Applied Technology, Martin Marietta Energy Systems, Inc., Mr. E. J. Miles, Director, Fuel Cycle Materials and Service Department, Westinghouse Electric Corporation.

IV. EXPLANATION OF SUBCOMMITTEE ACTIONS

A. Energy Supply Research and Development

1. Supporting Research and Technical Analysis

Supporting Research and Technical Analysis is a broad area of research and related activities that includes four programs plus advisory and oversight functions. The research activities include Basic Energy Sciences, Energy Research Analyses, University and Science Education, and Multiprogram Energy Laboratory Facilities Support. In addition, Advisory and Oversight Program Direction is provided. The primary program in terms of funding and scope within Supporting Research and Technical Analysis is the Basic Energy Sciences.

The Fiscal Year 1991 funding and the DOE budget request for FY 1992 funding by program are provided below:

Table 1

Supporting Research and Technical Analysis
($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
Basic Energy Sciences	$711.8	$714.7
Energy Research Analysis	$3.7	$4.0
University and Science Education	$46.6	$48.9
Advisory and Oversight	$4.2	10.1
Multiprogram Laboratory Facilities Support	$23.6	$23.9
Total	$789.9	$801.6

Discussion of each of the major programs and the major policy issues follows:

a. Basic Energy Sciences

Program Description

The Basic Energy Sciences (BES) program is composed of six major technical subprograms which correspond to distinct but often related areas of scientific investigations. These subprograms include: Materials Sciences, Chemical Sciences, Applied Mathematical Sciences, Engineering and Geosciences, Energy Biosciences, and Advanced Energy Projects. Each of the program areas fund research at the national laboratories and at universities and other government and private research facilities. The percentage of funds expended at the national laboratories versus the universities varies significantly for each of the subprograms.

Table 2

Basic Energy Sciences

Funding History

($ in Millions)

Fiscal Year	Actuals
1978	$180.4
1979	$204.7
1980	$223.1
1981	$227.5
1982	$241.2
1983	$282.4
1984	$335.5
1985	$412.5
1986	$419.9
1987	$519.5
1988	$557.7
1989	$545.9
1990	$564.1
1991	$711.8

In FY91 the Basic Energy Sciences (BES) program received an appropriation of $711.8 million; for FY92 the Department has requested $714.7 million. Table 3 below provides a breakdown by major subprogram and also identifies funding used to support the operation of User Facilities, a rapidly increasing funding commitment. Basic Energy Sciences research projects provide the research knowledge base not only for energy technology developments, but often lead to breakthroughs in waste cleanup technologies. These breakthroughs have the potential to reduce the cost of cleaning up DOE facilities by billions of dollars.

Table 3

Basic Energy Sciences Funding
($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
Materials Sciences	274.9	257.1
Facilities Operations	(77.6)	(100.4)
Chemical Sciences	157.6	158.3
Facilities Operations	(58.1)	(60.3)
Applied Mathematics	52.7	75.5
Engineering Research/ Geosciences	34.3	35.8
Advanced Energy Research	24.8	10.8
Energy Biosciences	22.0	24.7
Program Direction	6	7.5
Subtotal Operations	572.5	569.7
Facilities Operations	(135.7)	(160.7)
Capital Equipment	36.8	37.0
Construction	102.4	108.0
Total BES	711.8	714.7

Materials Sciences

The Materials Sciences subprogram seeks to improve our theoretical and experimental capability to analyze the fundamental structure and behavior of materials. The result of this research often leads either to the development of advanced materials with unique properties (e.g. corrosion resistance or strength) or the development of processes to make existing materials more efficiently. This research is of special significance to high temperature superconductivity, condensed matter physics, metallurgy and ceramics. The pace of technology advancements is increasing in this highly competitive field. In the United States there is growing interest in coordinating the national efforts in this area into a materials sciences initiative involving the national laboratories, other government laboratories, the university community and the private sector.

In addition to funding research projects, the BES Materials Sciences subprogram is one of the principal funding sources for unique scientific and technical capabilities and facilities in the United States, such as, the electron microscope at the Lawrence Berkeley Laboratory which is capable of imaging individual atoms.

These major facilities (referred to as "user" facilities) are made available for experiments conducted by the national laboratories, other government, private, university and industry laboratories, the international science community, and industry. Because of the cost of building and maintaining these facilities and their importance to science and technology, the time available to users is allocated on a merit basis determined by a panel of peers who review and prioritize proposals. Due to the unique capabilities of these facilities, there are always more proposals than available machine time can accommodate.

Several of the user facilities in the United States were built in the 1950s and 1960s and are approaching the limit of their useful life or are no longer considered world class facilities. Recognizing the essential role of these facilities in technology development (especially in materials, chemistry, geology, and biology), the U.S. has begun a major upgrade program in an effort to make facilities competitive with those in Europe and Japan. Two new light sources (one for materials surface analysis and gas spectroscopy, and the other for materials structural analysis) are under construction. The Advanced Light Source (ALS) will be completed in FY 1993 and the Advanced Photon Source (APS) will be completed in 1996. Both will provide capabilities essential for technology development by American industry as well as supporting the basic sciences and the research needs of the laboratory community.

The U.S. neutron beam facilities are also aged, having been commissioned in the mid 1960s. The DOE has proposed building a new neutron facility which is presently undergoing conceptual design and safety analysis; if this project proceeds as planned, the Advanced Neutron Source will formally become a construction project in 1993. This facility, which could be completed around 2001, would replace the High Flux Isotope Reactor (HFIR) and High Flux Beam Reactor (HFBR) both of which will be approaching 40 years of age at that time. Expert witnesses appearing before the Subcommittee have stated that the existing facilities (HFIR/HFBR) are beginning to show signs of neutron embrittlement and estimate their useful life at between 10 and 15 years from today.

Neutron facilities are an essential tool in the study of lighter elements, such as carbon and hydrogen, which are used in polymers and organic substances. In addition, neutron beams complement the analysis performed by light sources; using both neutron and X-ray analysis yields the maximum information regarding the structure, composition and characterization of materials. The investment in new user facilities is well timed to support growing interest in a national initiative in the materials science and research area.

Chemical Sciences

The Chemical Sciences subprogram investigates the chemical properties of matter and the interactions of component molecules, atoms, ions and electrons. Advances in knowledge are often applicable to the extraction of fuels and chemicals from coal, nuclear waste separation, biomass conversion to liquid fuels, and detection and measurement of harmful products from energy processes.

This area of scientific investigation has become increasingly important in providing basic research and knowledge of particular significance to the ultimate development of waste cleanup technology. The Subcommittee believes that investment in chemical sciences may lead to major technological breakthroughs in waste cleanup methods. These breakthroughs could save the DOE billions of dollars in providing cleanup techniques that are both less costly and more effective. In addition, it could result in savings for U.S. industry of hundreds of billions of dollars in its efforts to clean our environment.

Applied Mathematical Sciences

The Applied Mathematical Sciences subprogram supports all aspects of mathematical and computational research. The subprogram also provides access to expand the capabilities of the DOE's super computing facilities used by national laboratory and outside researchers supported by the DOE research programs.

A significant portion of the FY 1992 funding ($28 million) is provided for support of the High Performance Computing and Communications (HPCC) Initiative. The HPCC capability is an important element in maintaining U.S. competitiveness in most fields of science and technology. Funds will provide for research, assessment, and the development of new computer architectures used for computation and modeling.

Engineering and Geosciences

Two broad disciplines are included in the Engineering and Geosciences subprogram. Research in engineering seeks to expand our knowledge of processes and concepts that underlie current engineering practice. This knowledge provides a broadened technical base for solving engineering problems related to energy technologies. Projects deal with our basic understanding of basic, but important, topics such as, the flow of oil, gas and water through porous materials such as soil or rock. The knowledge gained in this type of research serves as a basis for development of enhanced oil recovery techniques.

Geosciences research emphasizes the development of the productive understanding of the energy related aspects of geological, geophysical and geochemical processes. High resolution underground imaging is one of the important projects carried out in the Geosciences activity.

Advanced Energy Projects

The Advanced Energy Projects Subprogram explores the feasibility of novel energy related concepts which emerge from basic research but are not sufficiently defined and understood to move forward into technology development. Several projects are on-going and will continue into FY 1992; these include innovative techniques for oil spill cleanup, unconventional fossil fuel technology, and processing techniques for high temperature superconducting materials. New projects are constantly moving into this subprogram as more mature projects are moved into technology development or set aside when not of sufficient promise to continue.

Subcommittee Recommendations

The Subcommittee supports the DOE funding request for Basic Energy Sciences in FY 1992 of $714.7 million, which includes funding for the completion of the construction of the Advanced Light Source (ALS) and continued construction of the Advanced Photon Source (APS). The Subcommittee strongly supports the budget request for the Molecular Science Research Center (MSRC). The Subcommittee also supports the upgrading of our Nation's user facilities. At the same time, the Subcommittee observes that once having constructed these facilities, we will then assume the obligation to operate and maintain them. The cost of this obligation is increasing rapidly because of the start-up of new facilities and the greater emphasis on environment and safety requirements which are essential, but add to the costs of operating these facilities.

The FY 1992 budget request for facilities operations increased significantly and now is approaching 40 percent of the Materials Sciences budget; similar levels are experienced in the Chemical Sciences budget. The Subcommittee is concerned that funds for the operation of these facilities will be obtained at the expense of the base research program. This would be unfortunate.

The Subcommittee recommends that the FY 1993 authorization provide funds for the rapid increases of facilities operations and that moderate levels of growth be provided for the base research program.

Table 4

Basic Energy Sciences

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
BES/Operating Expenses	$569.7	$633.6
(Facilities Operations)	($160.7)	($196.0)
BES/Capital Equipment/Construction	$145.0	$202.9*
Total	$714.7	$836.5

*Includes construction authorization in FY 1993 of $38.9 million for the ANS and $120.5 million for the APS.

In providing for the FY 1993 increase in authorization for the Basic Energy Sciences program, the Subcommittee recognizes the importance of these activities in providing the knowledge base for future energy technology developments and for the contribution to broader technology advances. While the Subcommittee believes all of the areas of investigation are important, advances in materials sciences and engineering technologies are of special significance at this time.

The Subcommittee recommends that the FY 1993 funding level for BES be authorized at $836.5 million. This includes $633.6 million for operating funds, $38.5 million for equipment and $164.4 million for construction, including funds for the General Plant Projects (GPP), Advanced Neutron Source (ANS), and Advanced Photon Source (APS); this will provide for the base research program and the operation of user facilities.

The Subcommittee believes that with the completion of the Advanced Light Source in FY 1992 the DOE should move forward with the Advanced Neutron Source and initiate construction of this project in FY 1993. This will be the final step in upgrading the national laboratory X-ray and neutron capabilities. The FY 1993 authorization of $836.5 million for

BES includes $38.9 million for initial construction activities for the ANS and $120.5 million for continuation of the APS. The Subcommittee authorizes funds in the amount of $93.0 million for FY 1994, and $45.0 million for FY 1995 for completion of construction of the APS.

Program Balance

The Subcommittee is concerned that the balance between the resources committed to research and scientific investigations and those required for the operation of user facilities at the national laboratories is entering a period of rapid change.

The construction of new user facilities is a major BES program objective for the 1990s. The Subcommittee believes these capabilities are essential if U.S. capabilities in science and technology development are to maintain their relative position with our competitors. However, once having put these facilities in place, the BES program (the Materials Sciences subprogram in particular) assumes the responsibility to operate and maintain them. This places a significant financial commitment on the program. If cost of living adjustments are the only increases provided to this program, then new user facilities can only be operated at the expense of the basic research program.

The Subcommittee is concerned that we may be embarking on a course of action that places our Nation in the position of having to choose between competitive user facilities (tools of science) or a basic research program, but does not provide for both. In the opinion of the Subcommittee, placing the program in such a dilemma guarantees a mediocre outcome. To address this potential problem, the Subcommittee recommends out-year authorization levels that provide for continuation of the basic research program and the operation of new user facilities.

User Fees

In the Omnibus Budget Reconciliation Act of 1990, P.L. 101-508, the DOE was directed to undertake a review of its user fee policies. The Subcommittee awaits with interest the findings of the DOE and any recommendations it may propose.

With history as a guide, however, the Subcommittee recognizes that past efforts to raise significant revenue through changes in user fees have been unsuccessful. Given our concerns over the ability of American industry to develop new technology to effectively compete in world markets, major increases in user fees could be counter-productive. In the face of the results of our past efforts to generate revenues through user fees and our national interest in a more cooperative technology development posture between government and industry, the Subcommittee does not believe that changes in user fee policy are a realistic method of addressing the program balance issue raised above. And while not wishing to prejudge the findings of the DOE, the Subcommittee will examine very carefully any proposal which essentially changes the nature of User Facilities at the national laboratories.

Participation of Historically Black Colleges and Universities (HBCU) in BES Programs.

A significant portion of the BES program funds are used to support scientific investigation and research at colleges and universities. The Subcommittee has found that HBCU have had little, if any, participation in these programs. In its hearings, the Subcommittee was informed that such institutions are "at a great disadvantage in competing for such grants." In effect, they face a "chicken and egg" problem. Without scientific faculty members of national stature, HBCU are unlikely to be successful in competing for BES grant awards; yet, without a grant (or a large endowment) HBCU cannot attract this caliber of faculty who are in high demand nationally. Consequently, these schools have little hope of breaking into this circle and establishing themselves in one of these science fields.

The Subcommittee recognizes that despite the fact that demographic trends show that minorities will be the primary source of scientific and engineering talent in the next decade, little effort is being made to encourage HBCU to participate in these programs. Given the population trends, the Subcommittee believes it is prudent to take measures to provide opportunities for HBCU to develop their faculty resources, and thereby student talents, through participation in BES grant programs.

The Subcommittee directs the DOE to provide to the Congress, within six months after enactment, a plan to encourage HBCU to submit proposals for BES grants and to provide opportunities for these institutions to successfully compete for such grants. Given the exemplary record of the DOE in creating innovative science and engineering educational programs for minorities, the Subcommittee is confident that the DOE will develop an effective plan for addressing this issue.

New Construction Projects

Given the Subcommittee's concern for maintaining program balance between the basic research program and support for user and other facilities, the Subcommittee believes that greater attention must be given to the initial decision to undertake such construction projects. In particular, the Subcommittee believes that both the total project cost and the commitment to additional operating costs must be carefully weighed. Therefore, the Subcommittee requires that before new construction projects in excess of $10 million can be undertaken they must be authorized in their entirety by the Congress; construction projects over $100 million are classified as major construction projects. Both categories are discussed in Section V.

b. Energy Research Analyses

The Energy Research Analyses Program carries out technical assessments on DOE civilian research and development programs and projects. These analyses provide comprehensive evaluations of the programs and identify new directions that future research and development programs should take to be more productive and relevant to DOE missions.

The Subcommittee believes this program provides an important capability and recommends that it be authorized in FY 1992 and 1993.

The Subcommittee authorizes $4.0 million for FY 1992 and $4.2 million for FY 1993 for Energy Research and Analyses.

c. Multiprogram Energy Laboratories - Facilities Support

This program provides funding for timely rehabilitation and replacement of general purpose facilities at the Energy Research Laboratories. The projects are intended to combat problems associated with aging and obsolescence, in addition, it provides funds for the Office of Energy Research to correct environment, safety and health inadequacies at multiprogram laboratory facilities that require immediate attention.

The Subcommittee is concerned that the age of laboratory facilities and the requirements to bring these facilities into compliance with environment, safety and health regulations could combine to escalate the demand for funds for this activity. In order to provide a background for understanding such needs, the Subcommittee requests that DOE provide relevant historical information regarding the age of these facilities, their condition, and investment history, such as, dollars per square foot for rehabilitation, replacement or other activities required to adequately maintain these facilities. The Subcommittee also requests that long range projections of the future funding requirements for this program be provided with appropriate explanation of deviations from existing trends.

The Subcommittee authorizes $23.9 million for FY 1992 and $24.9 million for FY 1993 for laboratories facilities support.

d. Advisory and Oversight Program Direction and Policy Management

The Subcommittee authorizes $10.1 million for FY 1992 and $10.5 million for FY 1993 for Advisory and Oversight Program Direction and Policy Management. The FY 1992 funding request will provide staffing required by the Director of Energy Research to carry out his responsibilities, including support for the Secretary of Energy Advisory Board.

e. University and Science Education

Program Description

The DOE is broadening its effort to address some critical areas, including pre-college programs and programs to attract minorities and women to the fields of science, engineering and mathematics. While DOE and its predecessors have long had a relationship with the academic community, these programs traditionally were designed to meet the needs of the graduate level and post doctoral level.

The dedication of DOE to science and mathematics education is commendable. The Subcommittee strongly supports efforts to enhance and expand these programs.

The Nuclear Engineering Research and Education Program was created by Congress in FY 1988 under the Laboratory Cooperative Science Centers to provide support for university based nuclear engineering research and education programs. The program awarded, through peer review, competitive projects for both graduate research fellowships and laboratory/university research projects.

The University Research Reactor Program has been a part of DOE and its predecessors since the early 1950s, when the first university reactor became operational at North Carolina State University in September 1953. Although this program was established for education and research related to nuclear science, technology, and radiochemistry, the reactors have since become a multi-disciplinary tool involving physics, chemistry, biology, medicine, and materials sciences.

While originally set up to conduct education and research, the current research reactors rely on the University Research Reactor Program for much needed upgrades. The Subcommittee has found that as DOE has moved these programs from one budget area to another, they have suffered. Today, the number of colleges and universities which offer any curriculum in nuclear engineering and related technologies is declining. This is particularly worrisome because the Federal government and DOE in particular are among the largest employers of nuclear graduates, and it is, therefore, appropriate that they sponsor these important programs.

Table 5

University and Science Education

Funding History

($ in Millions)

Includes Nuclear Engineering Research/
Education and University Research Reactor Programs

FY81	$13.2
FY82	$11.9
FY83	$ 7.6
FY84	$10.9
FY85	$20.1
FY86	$20.8
FY87	$24.7
FY88	$30.2
FY89	$34.4
FY90	$38.8
FY91	$46.6

Table 6

University and Science Education

($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
University and Science Education	$40.6	$47.9
Nuclear Engineering Research and Education	$5.0	0*
University Research Reactors (upgrades)	$1.0	$ 1.0
Total	$46.6	$48.9

*The DOE has stated that the Nuclear Energy budget requests $2.5 million for this program, but it also attempts to move the program out of the university education program.

Subcommittee Views

The Subcommittee applauds the foresight of the Secretary of Energy in recognizing the importance of "fortifying foundations" as a critical element of our National Energy Strategy. The DOE support for University and Science Education is in keeping with this important objective. However, the National Energy Strategy proposes that as many as 100 new nuclear electric powerplants will be built in the next 20 to 40 years. The average age of the teaching staff for nuclear technologies is about 10 years older than the national average of faculty for other engineering disciplines. This is largely due to the lack of new faculty entering these fields. In addition, we will also lose expertise in the private sector nuclear industry as older personnel retire and fewer new graduates enter these fields. The majority of graduate students in nuclear technologies are foreign students and often are not eligible for U.S. government jobs in sensitive areas in these fields. The Subcommittee believes activities must begin now to address this issue in order to maintain our technological capabilities.

DOE's FY91 University and Science Education program requested no funds for nuclear education and only $1 million for reactor upgrades (to complete one project). Unfortunately, DOE did not seek funds for these programs in the FY92 request, claiming budget constraints. A request of $2.5 million was included in the Nuclear Energy budget to complete funding for the existing research grants and fellowships. (This would not allow any new ones.) The

Congress provided a total of $6 million for these programs in FY91 and has traditionally supported the programs.

Subcommittee Recommendations

The Subcommittee is concerned with the lack of support at DOE for these programs particularly in view of the Departments recognition of the need to build fortifying foundations. The Subcommittee believes that the programs are interdependent and that consolidation provides advantages for both programs. Therefore, the Subcommittee directs that the Nuclear Engineering Research and Education Program and the University Research Reactor Program be combined to form the Nuclear Engineering Education and University Research Reactor Program and included as part of the University and Science Education Program.

The Subcommittee fully supports efforts to expand the other university and science education programs, but opposes the elimination of these two subprograms, namely, Nuclear Engineering Research and Education and the University Research Reactor Programs. In consolidating these programs, the Subcommittee intends that the programs be directed and managed by the Office of Energy Research as part of the University and Science Education program.

The Subcommittee recommends that funding for the combined programs be authorized at $8.5 million for fiscal year 1992 and $22 million for FY93. The overall authorization for University and Science Education (including the Nuclear Engineering and Research Reactor programs) is authorized at $57.5 million for FY 1992 and $72.9 million for FY 1993.

Table 7

University and Science Education

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
University and Science Education	$49.0	$50.9
Nuclear Engineering Education and University Research Reactors	$8.5	$22.0
Total	$57.5	$72.9

2. Nuclear Energy

a. Nuclear Energy Research and Development

Program Description

The civilian nuclear energy program includes research and development on a number of different types of nuclear reactors. While they all depend on the fissioning of heavy nuclei (such as uranium-235) to produce energy, they differ in the coolant used, the control and moderation of neutrons, and in the type of fuel used in the reactor. Among the coolants used are water (called "light water"), helium gas, and liquid metal, such as sodium. Reactor types are generally named for the coolant used.

The budget history of the Nuclear Energy Research and Development program is in

Table 8.

Table 8

Nuclear Energy Research and Development

Funding History
($ in Millions)

Fiscal Year	Appropriations
1978	$573
1979	$859
1980	$848
1981	$789
1982	$812
1983	$704
1984	$630
1985	$414
1986	$374
1987	$327
1988	$346
1989	$353
1990	$342
1991	$306

Nuclear electric power plays a key role in supplying electrical energy for America. Today commercial nuclear powerplants generate about 20 percent of the United States' electricity supply. All of the operating commercial nuclear reactors are of the light water type, either Pressurized Water Reactors (PWR) or Boiling Water Reactors (BWR).

From an environmental viewpoint, a major benefit of nuclear electric power generation plants is that they emit no greenhouse gases and, hence, are not a contributing factor to the growing concern over the issue and implications of global warming.

The DOE Nuclear Energy program is composed of six major program budget areas (Table 8).

For the nuclear energy program, the Administration's request for FY 1992 reflects a substantial increase relative to FY 1991. However, a significant portion of this proposed increase is for two space related programs (in which DOE, National Aeronautics and Space Administration (NASA), and the Department of Defense (DOD) are involved), namely, Space Reactor Power Systems and the Space Exploration Initiative (SEI).

Table 9

Nuclear Energy
($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
Light Water Reactors	$98.5	$62.5

Advanced Reactors, Research and Development	57.0	49.5
Space Reactor Power Systems	33.5	56.0
Advanced Radioisotope Power Systems (Space)	75.5	56.0
Space Exploration Initiatives, SEI	0.0	30.0
Facilities (Operating, Equipment, and Construction)	92.5	127.8
Program Direction	8.8	16.1
Total, Nuclear Energy	$305.8	$398.0

Light Water Reactors Program

Utilities have focused primarily on light water reactors (LWRs) as the likely technology for a new generation of nuclear powerplants; this builds on the extensive U.S. and worldwide operating experience with LWRs. The principle ongoing activity for light water reactor development is the certification of standard designs, pursuant to new regulations of the U.S. Nuclear Regulatory Commission (NRC). A certified design would allow U.S. utilities to build such plants under more streamlined regulatory review procedures. An appropriate analogy is in the civilian aircraft industry, wherein a new passenger plane design is first certified and then airlines can place orders and use the aircraft with confidence.

There are four ongoing certification programs supported by the DOE; all are cost-shared with the reactor manufacturer and the DOE, each contributing half of the costs. Table 10 below shows the reactor manufacturer, the reactor type, and size, the start and completion dates and the funding limit for DOE participation.

Table 10

Light Water Reactor Certification

($ in Millions)

Reactor Type	Size in Megawatts	Reactor Manufacturer	Year Started	Estimated Year Completed	Total DOE Funding
PWR*	1300	ABB/Combustion Eng	1987	1993	$23.6
ABWR	1300	GE	1987	1993	$13.5
SBWR	600	GE	1990	1995	$50.0
PWR**	600	Westinghouse	1990	1995	$50.0

PWR* Pressurized Water Reactor, System 80+
ABWR Advanced Boiling Water Reactor
SBWR Simplified Boiling Water Reactor (Passive Design)
PWR** Pressured Water Reactor, AP600 Advanced Passive

DOE funding for the certification project is limited to $50 million for any one design; however, in addition to DOE funding support, private sector funding will be approximately $70 million for each passive reactor design (SBWR and PWR).

First-Of-A-Kind Engineering

As a follow-on to the certification program, the DOE is recommending First-Of-A-Kind Engineering activities for the certified designs.

First-Of-A-Kind Engineering is defined as the non-recurring engineering effort to produce the detailed design information for a particular standard design, beyond the level-of-detail that is required for design certification by the Nuclear Regulatory Commission (NRC). In response to this request, in the FY 1992 budget submission to the Congress, DOE proposes to initiate a First-Of-A-Kind program to perform more detailed engineering of plant systems, key components, structural modules, and systems beyond that needed for certification. The goal is to achieve commercial standardization of the entire plant; this would include the nuclear steam supply system and the balance of plant. The balance of plant has been the root cause of approximately half of all unplanned or shutdown outages of nuclear electric powerplants.

The Subcommittee recognizes, as with any technology, the product must first be built, operated, tested, and evaluated before it can be ready for market. The research, design and development of these reactors is a rigorous process involving the investment of resources on the part of the sponsors and the government. New nuclear reactors, like new aircraft, are brought into being by progressing through various stages of development from concept, through engineering design, component development, component testing, fabrication, on site construction, sub-system and system testing, evaluation, system component modification, installation of changes, systems testing and finally, government approval for commercial construction.

Advanced Reactors Research and Development

There are two major ongoing Advanced Reactor Research and Development programs underway; they are the Modular High Temperature Gas Reactor and the Advanced Liquid Metal Reactor which includes the Integral Fast Reactor.

Program Description

The DOE requested funding for two advanced nuclear reactor programs for FY 1992. The Subcommittee has supported both of these programs in the past, beginning on November 16, 1983, with the Modular High Temperature Gas Reactor. This initiative was based on the opportunity to build a safer reactor system and was made because of public concerns over the safety of existing nuclear powerplants. The "Modular High Temperature Gas Reactor" and the "Advanced Liquid Metal Reactor," each have the potential to provide an energy source which will shut down safely and without operator intervention under all conceivable accident conditions without the release of radioactive materials to the environment.

Modular High Temperature Gas Cooled Reactor (MHTGR)

The mid-term technology focus of the Advanced Reactor Program is the Modular High Temperature Gas Reactor (MHTGR). The MHTGR is designed to provide a high level of passive safety and to operate with helium coolant. This design has considerable commonality with one of the designs being considered for the New Production Reactor (NPR). The NPR is funded by DOE/Defense Programs.

The MHTGR possesses two unique features. First, it uses ceramic fuel particles with high-temperature heat resistant (up to 4350° F) coatings as a multiple and diverse barrier to the release of fission products. Second, it is the only reactor design which offers the potential for cogeneration applications for industrial process heat as well as commercial electric power producers.

The MHTGR design effort is being carried out by several participants. The proposed module size is for approximately 150 megawatts of electricity. Since 1978, nearly $416 million has been invested in the MHTGR through 1991.

In FY 1992 the MHTGR program plans to demonstrate fuel quality and performance, and to simulate heat removal from the core and pressure vessel. Specific activities will include fuel irradiation testing and the initiation of post-accident simulation testing of irradiated fuel, and an assessment of the direct cycle gas turbine and applications of process heat. Cooperative international research and development efforts will continue with France, Germany, Japan, and the United Kingdom.

The MHTGR program has progressed from the conceptual stage and is a candidate for a new production reactor to be built for defense purposes. The DOE has carefully integrated civilian with new production MHTGR design and development to achieve maximum cost effectiveness by common activities."

The DOE has not yet made its decision as to whether it should build a "heavy water" reactor or the MHTGR for production purposes. The Subcommittee recognizes the potential for capitalizing on this arrangement since the work done on the NPR would materially contribute to the development of the MHTGR for civilian purposes.

Until the decision is made on the NPR however, the future of the MHTGR program is unclear. Therefore, the Subcommittee directs the DOE to outline its plans for the continuation of MHTGR development in the event the DOE selects a heavy water reactor for the NPR. The DOE is therefore to submit a comprehensive civilian MHTGR Program Plan to the Subcommittee 90 days after enactment of this bill. This plan is to define the schedule, resources and complete cost estimates for a development program based on two alternatives, one including the NPR and the second the demonstration of a 425MW MHTGR plant at a location where the plant could stay in operation and be used for commercial purposes.

Advanced Liquid Metal Reactor (ALMR), and the Integral Fast Reactor (IFR)

The longer-term research and development project for the Advanced Reactors Program is focused on the Advanced Liquid Metal Reactor (ALMR) and the Integral Fast Reactor (IFR). The ALMR has the potential to address the waste issue through the separation and recycle of waste products back into the reactor. This process could reduce much of the resulting waste to short-lived isotopes. The ALMR concept utilizes natural circulation. Reactor tests conducted on EBR-II have demonstrated shutdown safety. Because the sodium will not boil, there is also less pressure and stress on the reactor vessel and the primary cooling system than would occur with water coolants.

The IFR development covers the reactor system as well as its complete fuel cycle ranging from fuel fabrication to reprocessing and waste management. The safety of the IFR system was demonstrated in a series of safety tests at the EBR-II facility. More recently, emphasis shifted to the demonstration of the performance of the new IFR fuel; the fuel performance, including long lifetime, has been demonstrated and the EBR-II test reactor is now completely furnished with the new IFR fuel.

Currently, the IFR program focus is on the demonstration of the innovative processing technology for spent fuel. The next major milestone is the completion of the refurbishment of the EBR-II Fuel Cycle Facility. When this is completed in late 1991, EBR-II and its Fuel Cycle Facility will start operating as a small scale pilot-plant. This demonstration, expected to be completed by the end of 1995, will include near-commercial-scale IFR fuel cycle processes and actinide recycle technology. The ALMR has the potential to address the waste issue through the separation and recycle of waste products back into the reactor. The waste recycle and burn-up efforts are in the experimental stages.

The on-site provision of fuel fabrication and waste treatment systems are attractive features for assuring safe operations While the waste treatment subsystem needs more research and development, there is cause to be optimistic about future progress in solving nuclear waste problems if such work is a cooperative effort including the national laboratories and U.S.-owned reactor manufacturers.

The ALMR development work has proceeded well and has been accelerated through the use of an existing reactor and other facilities at the Idaho National Engineering Laboratory (INEL). One of the difficulties in creating new technologies today, in government and industry alike, is in financing components and equipment needed to demonstrate the capabilities of a complete system. In this respect, the work at Argonne East and Idaho National Engineering Laboratory (INEL) has been performed on a very cost effective basis.

Space Reactor Power Systems

Besides nuclear energy technologies for civilian electric power use, the DOE Nuclear Energy Research and Development program also supports the application of nuclear power technologies to meet a variety of space and defense power requirements. The DOE pursues these efforts as part of its charter under the Atomic Energy Act.

This program embraces two main activities: the tri-agency (DOE, NASA, DOD) SP-100 space reactor power system that is the principal thrust of the Nation's space reactor efforts and the backup effort on thermionic reactor systems technology. Both programs are supported and jointly funded by DOE with NASA and/or DOD. DOE's FY 1992 funding request of $56.0 million, represents an increase of $22.7 million over its FY 1991 appropriation or nearly a 70 percent increase. This level of funding provides for DOE participation in the SP-100 program as was proposed in the amended Memorandum of Agreement signed in late 1989 with NASA and DOD.

The SP-100 reactor system aims to develop, demonstrate, and make available space nuclear reactor technology capable of generating hundreds of kilowatts, thus meeting the power requirements of a variety of civilian and military applications during the early 2000s and beyond. The program is in its sixth year of designing and engineering a ground test reactor and conducting tests of nuclear fuel, materials, and components.

Advanced Radioisotope Power Systems

The purpose of the Advanced Radioisotope Power Systems program is to produce radioisotope power systems for U.S. civilian and military terrestrial and space missions. Radioisotope power systems, in use for almost three decades, are proven, reliable, and maintenance-free power supplies capable of producing up to one kilowatt electric (KWe) for tens of years.

The Advanced Radioisotope Power System program provides base support for radioisotope fuel and heat source development, production, and qualification; nuclear safety analysis and testing; power converter system development; and all aspects of manufacturing, quality assurance, reliability, and operational safety for radioisotope power systems.

Development efforts on the Thermionic Fuel Element (TFE) will continue in FY 1992. The TFE program includes insulator, fueled emitter, collector, and thermionic converter tests in irradiation facilities. It will continue component testing initiated in recent years and is expected to culminate with a prototypic test of a six-cell TFE in a fast reactor environment in FY 1995.

The DOE has reduced its funding request from $75.1 million in FY 1991 to $56.0 million in FY 1992. This reduction reflects the fact that efforts to restore production facilities started in FY 1990 and FY 1991 are nearing completion and that the construction of the Radioisotope Power System Facility is being deferred.

Radioisotope Thermoelectric Generators (RTG)

DOE programs in FY 1992 will continue to develop systems using RTGs and to provide improved RTG power systems and related technologies for future missions. These efforts are directed to improve heat source and converter performance and safety, to improve production efficiencies and reduce costs, and to pursue long-term technology development, especially in the thermoelectric materials area.

The facilities to process Pu-238 were placed on standby in the early 1980s and are in the process of being reactivated. Resumption of reactor operations, including Np-237 target irradiations, and the Pu-238 processing facilities will provide Pu-238 for the Comet Rendezvous Asteroid Flyby (CRAF) and Cassini missions by early FY 1993.

The emphasis in near-term efforts supports the CRAF and Cassini missions directed by NASA. To learn from the experience acquired from earlier RTGs, an FY 1991 effort will dismantle and analyze the qualification RTG for the Galileo and Ulysses missions after successful long-term life testing of over 53,000 hours. The backup Ulysses flight RTG has also been returned to monitored storage until it is needed for the CRAF mission.

Space Exploration Initiative (SEI)

The DOE is requesting $30 million in FY 1992 to initiate a cooperative, cofunded program with NASA to support the Space Exploration Initiative (SEI). This program is within the scope of the broad Memorandum of Understanding between DOE and NASA that was signed in FY 1990, but did not specify particular programs or funding levels. This new program proposes to develop nuclear propulsion and power systems and nonnuclear technologies for the manned exploration of the moon and Mars.

Efforts on nuclear propulsion are being initiated as one of the critical technologies for SEI because of its relative advantages over chemical propulsion. These advantages include the potential for shorter trip times, thereby reducing radiation exposure to the astronauts, and for smaller system mass resulting in lower launch costs. In its first year, this program proposes to evaluate nuclear propulsion concepts and associated technologies and will initiate development of key long term efforts. The program will also evaluate the facilities that will be needed for fuel fabrication, irradiation testing, and integrated propulsion engine testing.

Facilities

The operation of facilities provides for the safe and reliable experimental and test capabilities needed to develop civilian fission and fusion nuclear power technologies and systems, to support space and defense missions requiring nuclear power, and to support other programs. The DOE is requesting $127.8 million for support of the nuclear energy facilities for which it is responsible in FY 1992.

DOE is strengthening its management efforts to ensure the safe, environmentally acceptable, and reliable operation of its facilities. These efforts are intended to build on improvements in management and operations already made in response to the reviews by the National Academy of Sciences, and DOE's Advisory Subcommittee for Nuclear Facility Safety; the DOE intends to fully implement applicable Institute of Nuclear Power Operations (INPO) good practices.

In FY 1992, the facilities program plans to emphasize the following activities: the initiation of the IFR fuel cycle demonstration with metal fuel recovery and fabrication in the Fuel Cycle Facility, the conclusion of Tower Shielding Facility operations in support of the joint DOE/PNC (Power Nuclear Corporation/Japan) shielding program, and the performance of surveillance and maintenance.

There are two operating DOE Liquid Metal Reactors (LMR's) for research and testing of fuels and materials under fast neutron bombardment as opposed to slow neutrons in a light water reactor. The EBR-II at Idaho Falls, has been operating for 25 years. The Fast Flux Test Facility (FFTF) at Hanford has been running for nine years. The operation of the FFTF during FY 1991 is funded by the separate DOE account under Environmental Restoration and Waste Management.

Out of the concern for cost effectiveness, DOE conducted a comprehensive evaluation of long-term missions of the FFTF at Hanford, Washington. It determined that the amount of work done there, predominantly work done under the Advanced Reactors program, does not justify the expense of its continued operation and that essential testing done in the FFTF could be done in the EBR-II. Congress, in FY91, authorized continued operation of FFTF and directed the DOE to support an initiative by the Governor of the State of Washington to seek alternatives to sole government funding for the facility.

The State of Washington has enlisted the help of Westinghouse, the designer, builder and operator of FFTF under a contract with the DOE, to seek interest in an international program of research using the FFTF as a research center. These efforts are in the early stages of development; the prospects for success will not be known until March 31, 1992. The DOE FY92 budget request provides only for the shutdown of FFTF since results are not yet available from the Governor's initiative.

The major sites and the major facilities funded by the DOE FY 1992 budget request are summarized in Table 11.

Table 11

Major Facilities

Argonne National Laboratory West (ANL-W), near Idaho Falls, Idaho

EBR II	Experimental Breeder Reactor II
FCF	Fuel Cycle Facility
FMF	Fuel Manufacturing Facility
HFEF	Hot Fuel Examination Facility
TREAT	Transient Reactor Test Facility
ZPPR	Zero Power Physics Reactor

Westinghouse Hanford Company (WHC), near Richland, Washington

FFTF	Fast Flux Test Facility
FMEF	Fuels and Materials Examination Facility

Energy Technology Engineering Center (ETEC), near Canoga Park, California

Subcommittee Recommendations

The Subcommittee authorizes the funding for Nuclear Energy Research and Development for FY

1992 and FY 1993 as provided in Table 12.

Table 12

Nuclear Energy

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
Light Water Reactor (LWR)	44.5	62.5
Advanced Reactors Research and Development	60.5	73.0
Space Reactor Power Systems	36.0	36.5
Space Advanced Radioisotope Power Systems	56.0	58.0
Space Exploration Initiative (SEI)	5.0	5.0
Facilities (Oper., Equip. & Const)	178.8	168.8
Program Direction	10.2	16.2
Total	391.0	420.0

Light Water Reactors

The Subcommittee received testimony on the Light Water Reactor (LWR) program on March 6, 1991. At that time, the DOE stated that during fiscal year 1992, DOE and industry will continue with two cooperative cost-shared programs, to develop and certify advanced light water reactor designs. One program supports certification of two evolutionary standardized designs, while the second supports two advanced passive standardized designs. The objective is to have all four designs certified by 1995.

The Subcommittee agrees that the certification of standard reactor designs is a positive step toward revitalizing the nuclear power option and recommends continuation of support and completion of the System 80+, Advanced Boiling Water Reactor (ABWR), Advanced Pressurized Passive-600 Megawatt-electric (AP-600) and Simplified Boiling Water Reactor (SBWR) programs. The Subcommittee also believes that balance of plant considerations are an important part of this certification effort. Recent information indicates that more than half of all plant shutdown events are attributable to system elements beyond the nuclear steam system. If public confidence in nuclear power is to be restored, then the public must be assured that all design certification efforts address that portion of the plant most susceptible as an initiator of difficulties, namely, the balance of plant.

Furthermore, the Subcommittee does not support embarking on a new program for First-Of-A-Kind Engineering to develop a number of plant designs. The Subcommittee recognizes that it cannot properly support First-Of-A-Kind Engineering for four different reactor designs in the current or foreseeable budget climate. The Subcommittee believes the most important role that this program can play is to provide an incentive for taking the step of putting the first new reactor order on the books.

Therefore, the Subcommittee authorizes $2.0 million in FY 1992 for the specific purpose of initiating engineering design in support of the construction of a new nuclear powerplant. The design shall be in addition to that needed for certification and shall be based on one of the design concepts currently included in the certification program in accordance with the following provisions.

The DOE is to prepare and issue a Request for Proposals for Final Design Engineering, including site adaptation to U.S. owned reactor manufacturers, or those who will conduct the majority (75 percent) of their reactor design, manufacturing and construction activities in the U.S., who could respond as individual firms or in joint venture with other U.S. owned firms, in accordance with the following provisions:

1. The Offeror would have to provide a signed and notarized agreement from a licensed utility company, or other legitimate power producing organization, indicating the financing and resources to be committed by the utility over a specified period of time for the construction in the United States of one of the certified designs.

2. The reactor manufacturer would have to submit complete design and construction management plans including warranties for plant performance, power output and the useful life of major components and indicate how he would design and construct one of the NRC certified designs.

3. The reactor manufacturer would also have to submit signed and notarized warranties covering complete responsibility for the design, construction, and first year of plant operation. This responsibility must include the entire plant, including the balance of plant, and all facilities and equipment related thereto.

The offer is to be good for one and only one such undertaking and is not to be repeated. In order to qualify as the reactor manufacturer, the Offeror has to be the first firm to submit an acceptable proposal, complete with a utility agreement, to the DOE. Upon the receipt and acceptance of an offer from a U.S. reactor manufacturer and a utility company, no further similar authorizations will be made. The Subcommittee does not intend to authorize any other support for First-Of-A-Kind Engineering.

The Request for Proposals is to provide for an extended period of time in which to respond. Given the prevailing constraints in building new nuclear plants, the proposal period could be open for well over a year. In consideration of an acceptable offer, the Federal Government would provide matching funds up to a limit of $20 million each year, for a total of $60 million, over three years to assist in the design, construction and initial equipment procurement for a full scale previously certified civilian nuclear reactor.

Subcommittee Recommendations

Advanced Reactors Research and Development

In spite of the achievements and promise of safer nuclear power, the Subcommittee would like to see more rapid progress on the advanced reactor programs. While the Subcommittee recognizes funding limitations, the Subcommittee also notes funds budgeted by the DOE for other programs where the potential benefits to the American public are much less clear.

On the MHTGR, the Subcommittee views that the budget allocation implicit in the Administration's FY92 request to the Congress for the advanced reactors is inadequate -- especially if that design concept is not selected by DOE in December 1991 as the technology for the New Production Reactor (NPR).

The Subcommittee authorization provides $60.5 million for FY 1992 and $73 million for FY 1993 for the Advanced Reactors Research and Development program. Of this total the

Subcommittee recommends $41 million for FY 1992 for the ALMR development and $16.5 million for the MHTGR development. The Subcommittee supports current participants on the University Research program in Robotics funded through the Advanced Reactors program at a level of $3.5 million in FY 1992 and $3.5 million in FY 1993. Given the likelihood that radiation exposure limits for workers may be further reduced in the future, the Subcommittee believes the Robotics program is a prudent investment in technology development and compatible with the overall Advanced Reactors program goals. Finally, as was discussed in the University and Science Education section of this report, the Subcommittee has directed the DOE to fund Nuclear Engineering Education and the University Research Reactors program under the University and Science Education program.

Space Reactor Power Systems

The Subcommittee recommends $36 million in the DOE FY92 budget for the nuclear reactor space power program. The focus now is on component development and qualification. It is the Subcommittee's recommendation that at this stage NASA and DOD should pick up more of the funding instead of DOE. The Subcommittee views that the Space Reactor Power System, particularly the SP-100, is in need of further definition in context of specific mission needs.

Space Exploration Initiative (SEI)

The Subcommittee authorizes $5 million for SEI for Fiscal Year 1992. This amount is sufficient in this very early, generic phase in support of possible use of nuclear technologies in future missions of exploration to the Moon and Mars. The Subcommittee recommends that the eventual user agencies, NASA and DOD, should contribute principally to this effort until such time that mission plans, schedules and requirements for nuclear propulsion and nuclear surface power are better defined and specified. The Space Exploration Initiative (SEI) is viewed as being quite generic and until there is more focus to the program, it would be premature to embark on a major research and development effort.

Facilities

The Subcommittee authorizes $178.8 million for facilities in the DOE's budget request for FY 1992 and $168.8 million for FY 1993. Within the $178.8 million for FY 1992, $79 million is authorized for the Fast Flux Test Facility (FFTF). The Subcommittee strongly supports continued operation of the FFTF during FY 1992 to allow sufficient time for the State of Washington to fully explore possibilities for more international participation, including funding from countries such as Japan. Following this one year extension, the FFTF Facility should be re-evaluated to determine if it is realistic to continue, such as with cost sharing with non-governmental portions. If a cost-sharing agreement is reached for continued operation of the FFTF by March 31, 1992, the Subcommittee authorizes not more than $69 million for FY93.

In support of the mission of the State of Washington in regard to the Fast Flux Test Facility (FFTF), the Subcommittee fully supports the establishment of the FFTF as a multi-mission research and development center (Research Reactor User Complex (RRC)) which will be operated by the DOE in partnership with international and domestic user organizations.

The Subcommittee supports authorizing agreements between DOE and non-Federal entities (which includes foreign governments, and other entities) of a consortium of such entities to use the FFTF RRC for: (1) the production of industrial and medical isotopes, (2) irradiation services which support research and commercialization objectives, and (3) production of steam

The establishment of the FFTF RRC by DOE should take place within 90 days of enactment. Agreements between DOE and non-federal entities, including foreign governments and entities, is authorized. DOE is also provided with authority to assess necessary or appropriate charges from the non-Federal entities and to make agreements with the non-Federal entities for no more than 25 years.

There is authorized termination provisions in the agreements which DOE makes with non-Federal entities, which require DOE to pay for the unamortized balance of any depreciable structures, equipment, materials, or services built, acquired, or provided by the non-Federal entities. However, the termination provisions will only apply if the RRC is shut down for lack of Federal appropriations and, the depreciable property or materials represent a significant portion of the non-Federal entities overall investment under the agreement.

The DOE is also authorized, as part of any agreement, to: (1) provide any necessary services, (2) lease property, (3) offer appropriate indemnification pursuant to the Price-Anderson Act, and (4) include any appropriate terms and conditions.

The Secretary of Energy is permitted to use competitive procurement procedures other than those described in the Federal Property and Administrative Services Act.

It is required that the DOE contractor operating the RRC maintain and operate the facility pursuant to the Atomic Energy Act, ensure that all experiments meet applicable safety requirements, and provide necessary support services to the non-Federal entities.

There is also established the RRC Fund which will consist of all revenues received from the charges assessed to non-Federal entities. DOE is authorized to use the funds in the RRC Fund to offset the operating costs of the RRC and any remaining sums must be invested in U.S. securities with interest accruing to the fund.

Program Direction

The Subcommittee authorizes $10.2 million for FY 1992 and $16.2 million for FY 1993.

b. Civilian Radioactive Waste Research and Development

Program Description

The Office of Civilian Radioactive Waste Management (OCRWM) was created to carry out the missions of the Nuclear Waste Policy Act (NWPA) of 1982, P.L. 97-425, as amended. The DOE is responsible for implementing the NWPA and has encountered strong opposition in developing a permanent geologic repository. The research and development directives in the law are now being performed by DOE Defense Programs and the OCRWM is not conducting any research or development activities relating to high-level radioactive waste issues or technologies. The federal government, under the NWPA, is required to take title to the spent fuel of our nation's reactors by 1998. The latest estimate from DOE is that a repository will not be ready until at least 2010.

Currently, each commercial reactor stores its spent fuel on-site at the reactor. There are 111 licensed reactors in the U.S. and a few have terminated operations, but spent fuel remains at those sites. Some of the older reactors are approaching their full capacity for storing spent fuel in their pools. Large pools of water are used to dissipate the thermal heat of spent fuel, and water also serves as a shield to protect against radiation exposure.

The Civilian Radioactive Waste Research and Development, a subprogram under Nuclear Energy, has participated in an industry cost-shared project to study consolidation and dry cask storage which has proven successful. The FY91 appropriation and the FY92 request, $696,000 and $700,000, respectively, clearly show that this is the only research and development activity currently pursued by the DOE in civilian nuclear waste research and development.

Table 13

Civilian Radioactive Waste Research and Development

Funding History
($ in Millions)

FY84	$2.75
FY85	$25.89
FY86	$15.99
FY87	$6.49
FY88	$5.0
FY89	$2.5
FY90	$.98
FY91	$.70

Table 14

Civilian Radioactive Waste Research and Development

	FY 1991 Appropriations	FY 1992 Request
Civilian Radioactive Waste Research and Development	$696,000	$700,000

Subcommittee Views

The Subcommittee commends the DOE for its efforts in supporting the utility industry in order to safely manage on-site nuclear waste storage.

While a geologic repository seems to be the solution today for long term storage/disposal of high-level waste, the Subcommittee believes there are ample opportunities to perform research and development to assist in resolving some of the problems from a different perspective. Research and development could be valuable in reducing the half-life of the highly radioactive material through transmutation, or research and development of new technologies could lead to new methods of reducing the volume. In voicing this opinion, the Subcommittee likewise rejects the view held by some that progress in developing new technologies to mitigate the problems surrounding nuclear waste will be used as a rationale to further delay the completion of the repository.

The Subcommittee is disappointed in the DOE's failure to support technology advancements in the mitigation of nuclear waste. While the research and development in actinide burning currently underway at INEL through the Integral Fast Reactor Program is encouraging, a much stronger program is needed for a complete solution to the nuclear waste problem.

The nuclear waste problem is seen as a challenge to America's science and engineering communities, including those in laboratories, industries, and universities. The problem is not only difficult, but it requires that a multitude of resources be brought to bear on a common objective; providing for the safe management, storage and disposal of nuclear waste within time periods acceptable to the public.

The Subcommittee is familiar with the primary thrust of the U.S. program directed toward repositories. While the solidification of high-level waste coupled with repository disposal offers many advantages, future waste mitigation alternatives may prove to be more complete and provide for shorter periods from after reactor radiation levels to background radiation levels. To this end, the Subcommittee is pleased with the work at the national laboratories and certain private sector companies.

The Subcommittee is not pleased with the inability of the nuclear community to work in consort on a unified national nuclear waste mitigation effort. The Subcommittee is also disappointed with DOE's lack of commitment and inability to lead such an effort as evidenced by the lack of emphasis reflected in the FY92 budget. The Subcommittee believes that nuclear waste issues must be effectively addressed if nuclear power is to play a more prominent role in meeting our future energy needs.

There appears to be at least three potential efforts that may well be supported individually, as well as from the point of possible synergistic interaction.

(1) An accelerator to transmute nuclear waste into products with shorter half-lives and which could thereby significantly reduce nuclear waste storage periods. There is also the potential for a thorium fueled gas reactor in the future which could mitigate its own nuclear waste while producing electricity.

(2) The continuation of actinide burning development offers much potential. Considerable effort has gone into this work, and the results to date have been encouraging.

(3) Finally, the last effort is one of basic research and support for the aforementioned efforts. Hopefully, the resources of our universities could be enlisted to work on this national problem.

Table 15

Civilian Radioactive Waste Research and Development

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
Civilian Radioactive Waste Research and Development	8.0	8.32

The Subcommittee authorizes $8 million in FY 1992 and $8.32 million in FY 1993 to increase the resources dedicated to nuclear waste mitigation. This additional funding is also to enable DOE to organize and staff a program office for the purpose of bringing together the national laboratories, universities and private sector organizations who can contribute to advancements in solving the nuclear waste problem in a cohesive and integrated program. Specifically, the program shall include the Argonne National Laboratory, the Pacific Northwest Laboratory, the Lawrence Livermore National Laboratory, the Los Alamos National Laboratory, and private firms having experience in nuclear reactor waste mitigation.

Therefore, DOE is to review past accomplishments, identify the technical needs for continuation of existing programs or the initiation of new efforts, structure a plan for implementing the necessary action and report to the Congress within 90 days after enactment, on its findings, objectives, management, estimated cost, and schedule for pursuing waste mitigation research and development.

The Subcommittee intends to continue with this program in FY93. The DOE will provide for future budget requests, a program plan with milestone objectives which clearly establish progressive goals, schedules, and estimated costs. After FY93, the Subcommittee will reassess the progress made in order to determine the extent of continuing effort. It is the Subcommittee's intention to have DOE structure a small program staffed with the most capable personnel knowledgeable in the disciplines appropriate to solving the waste problem and who can work together effectively across organizational boundaries.

3. Fusion Energy

Program Description

The civilian fusion energy program includes research and development on two fundamentally different approaches: magnetic and inertial confinement systems. Both rely on the principle of conversion of mass to energy when two light nuclei, such as hydrogen and deuterium, or deuterium and tritium come together and fuse at very high temperatures. For magnetic fusio , this reaction would occur in the regime of 100 million degrees. Fusion is the opposite of fission, in which a heavy isotope, such as uranium 235, is split apart by an incoming neutron thereby releasing kinetic energy. The harnessing of fusion will have not only enormous energy benefits but also will be relatively benign environmentally.

Table 16

Fusion Energy

Funding History
($ in Millions)

Program	FY91 Approp.	FY92 DOE Request	FY92 Authorization	FY92 Recommendation
Base	175.0	167.2	167.2	160
TFTR	64.0	75.3	75.3	78
ITER/EDA	27.1	41.8	41.8	45
BPX	16.7	80.8	80.8	40
IFE	1.6	8.2	8.2	14
Capital Equip./ Construction	18.0	3.8	3.8	50
Total	289.6	377.1	377.1	387

Magnetic Fusion Energy

As a result of concentrated efforts throughout the industrialized world, a broad consensus now exists on how ignition can occur through magnetic confinement. Significant progress has been made toward this goal. To date, the most effective way to achieve magnetic confinement is in a torroidal, or doughnut-shaped device. The leading torroidal confinement concept is the Tokamak. In terms of fusion power production, the Tokamak has improved by more than a factor of a million over the past 15 years. Recent results indicate that the Tokamak Fusion Test Reactor (TFTR) at Princeton is close to break-even conditions, wherein the energy produced using the appropriate fuel would equal the energy applied to initially heat the fuel.

Inertial Fusion Energy (IFE)

The IFE technology differs fundamentally from magnetic fusion. Inertial fusion for energy applications will proceed by compressing a small deuterium-tritium fuel capsule to high density using pressure from uniform irradiation by short wavelength light or ion beams as drivers. According to validated physics models, the compression will heat the central core of the capsule in which rapid nuclear fusion reactions ignite the deuterium-tritium fuel. The heat from reaction-produced alpha particles will propagate through the surrounding high density fuel resulting in burning of most of the fuel and release of energetic neutrons. Net energy gain, defined as the ratio of fusion energy released to input driver energy, should be possible with a ratio up to about 100.

Objectives

The goals of the redirected fusion program are to achieve a demonstration plant by the year 2025 followed by a commercial powerplant by 2040. The strategy is to support two separate and distinct approaches to fusion energy development: magnetic fusion energy and inertial fusion energy. The pursuit of both options will reduce the technological risk associated with the difficult task of developing fusion energy. The strategy in each case is to gain scientific understanding of the complex processes involved in ignited and burning plasmas and to use this understanding to develop fusion technology in an engineering test facility. The final step toward commercialization would be the construction of a demonstration powerplant. The overall program must ultimately include the study and development of the most effective confinement systems, materials, and technology to ensure the eventual economic success of fusion. An important element in carrying out this strategy is to take full advantage of international collaboration while maintaining a sound domestic program.

Funding History

The nation's magnetic fusion energy (MFE) research program began in 1951 under the auspices of the former United States Atomic Energy Commission. Since 1972, the U.S. has spent over $8 billion, in constant 1990 dollars, on research into MFE. Table 17 shows the budget history since 1972 in constant 1990 dollars. In FY 1991, $273 million was appropriated for the MFE program. In January 1991, the Secretary of Energy asked the Congress for authority to reprogram $25 million from other parts of DOE to MFE (which was approved).

For FY 1992, DOE has requested $337.1 million for the magnetic fusion energy program. This funding is less than that recommended by the report (issued in September 1990) of the Fusion Policy Advisory Subcommittee (FPAC). However, the redirected program, making a transition from a research oriented effort to an energy program, follows the FPAC recommendations and is also reflected in the President's National Energy Strategy.

Table 17

Magnetic Fusion Energy

Funding History
($ in Millions)

Year	Millions
1972	105
1973	120
1974	160
1975	300
1976	380
1977	675
1978	670
1979	660
1980	585
1981	605
1982	610
1983	580
1984	575
1985	510
1986	410
1987	380
1988	360
1989	365
1990	317
1991	298

The mainline U.S. magnetic fusion energy program now consists of three principal activities:

TFTR - Tokamak Fusion Test Reactor, located at the Princeton Plasma Physics Laboratory

BPX - Burning Plasma Experiment, proposed machine to achieve ignition by the year 2005. This machine is expected to cost $1 billion, and is now in the preliminary design phase.

ITER - International Thermonuclear Experimental Reactor

The most successful experimental magnetic fusion device thus far developed is known as a Tokamak. In the Tokamak, the plasma is contained in a torroidal (donut-shaped) chamber surrounded by magnetic field coils. Currently, the largest and most successful Tokamaks are the Tokamak Fusion Test Reactor (TFTR) at the Princeton Plasma Physics Laboratory (PPPL) in New Jersey and the Joint European Torus (JET) in England. The latter is a project being sponsored by the European Community. Both the TFTR and JET have succeeded in reaching a combination of density, temperature and confinement time of about 70 percent of that needed for energy break-even. The goal after breakeven is ignition. At ignition the energy generated by the fusion reaction is sufficient to cause other light nuclei to collide thereby sustaining the reacting system.

At this time it is expected that energy breakeven will be achieved in both the TFTR and JET in the next two or three years. To do so will require using deuterium (D-D) and tritium (D-T) in the experiment because of the large energy gain achieved from the D-T reaction compared to the D-D reaction. If the two Tokamaks were using deuterium and tritium now, they would both be very close to energy break-even.

Shifting to deuterium and tritium, however, will result in production of radioactivity at levels that would force either machine to be decommissioned after about two years. The reason is that tritium is naturally radioactive and the deuterium-tritium reactions produce large quantities of neutrons. Neutrons are responsible for producing most of the radioactive materials by way of nuclear reactions with atoms in the materials making up the containment structure.

Burning Plasma Experiment

The Burning Plasma Experiment is an important part of the magnetic fusion effort. In the past 15 years there has been no new major world-class fusion facility built in the United States, that is, one that would outperform the TFTR. The BPX would accomplish that next key step.

The purpose of the Burning Plasma Experiment is to investigate the physics of self-heated fusion plasmas and to demonstrate the production of 100 - 500 MW of fusion power. In the process the Burning Plasma Experiment will investigate the confinement physics, and operational limits of self-heated fusion plasmas. In addition it will demonstrate many of the heating, fueling, and plasma handling technologies necessary to produce reactor-level fusion. The Burning Plasma Experiment is intended to advance our knowledge of physics and technologies so that U.S. scientists and industries could effectively participate in the international collaborative effort to develop fusion power known as the International Thermonuclear Experimental Reactor (ITER). Current plans call for construction of the BPX to begin in FY 1993; the project is currently undergoing preliminary design and siting related activities, such as the preparation of the Environmental Impact Statement.

International Thermonuclear Experimental Reactor

The ITER provides a focus for the international collaborative effort to develop magnetic fusion power. There are four active co-equal partners in the ITER project. They are: 1) the United States, 2) the European Community, 3) Japan, and 4) the Soviet Union. The U.S. has entered negotiations to participate as an equal partner in the Engineering Design Activities of ITER. San Diego, California, is a candidate site for the Engineering Design Phase of the ITER program.

Tokamak Fusion Test Reactor (TFTR)

To contribute to the success of ITER and to maintain a strong domestic program, the U.S. will carry out Deuterium-Tritium (D-T) experiments in TFTR. These experiments are expected to lead to the attainment of break-even conditions. In addition, they will provide valuable experience in conducting experiments using tritium. The first experiments using D-T fuel are planned for FY 1993.

Civilian Inertial Fusion Energy (IFE)

The Civilian Inertial Fusion Energy (IFE) effort will be limited to a one-driver concept and to budget-paced technology development. This program will rely on continuing development of target physics and ignition characteristics within Defense Programs. The heavy ion driver, successfully conceived through Defense Programs and Basic Energy Sciences activities, is planned to be extended and tested. Technology research and development will be based on reactor studies and rely on progress within the world-wide magnetic fusion program for common elements such as low activation materials and breeding blankets.

Subcommittee Recommendations

The Subcommittee supports the policy that the program should move from a research oriented program to an energy technology development program. This is a major change in the character of the program and its objectives.

The Subcommittee is pleased that the Administration's National Energy Strategy (NES) report, recognized that the fusion effort is more than fundamental physics research but is an energy program with a mission of much potential and merits stable, long-term support. The Subcommittee also notes with satisfaction the comprehensive report of the Fusion Policy Advisory Subcommittee (FPAC) released in September 1990. The Subcommittee is of the view that the conceptual development program outlined by FPAC, with the constrained budget case, serves as a useful framework for on-going strategic planning of an integrated and coordinated fusion energy program with parallel magnetic and inertial efforts.

Taking into account the present status of the programs, the Subcommittee recommends focusing on three pivotal issues: (1) the introduction of tritium into the TFTR should proceed expeditiously so that Deuterium-Tritium experiments could be conducted in the facility by FY93; (2) the construction of the Burning Plasma Experiment (BPX) should be initiated as a line item project in FY93 with a scheduled completion, operational date during the year 2000; (3) the DOE should use all appropriate means to encourage that the next phase of ITER, the Engineering Design Activity (EDA), be sited in the United States.

The Subcommittee urges that DOE encourage more involvement of the private, industrial sector in all phases of the fusion program as it moves into the technology development phase. The DOE should require that contract proposals provide for significant industry participation, where appropriate, using a teaming effort with a national laboratory and a university in carrying out the particular project.

The Subcommittee is concerned that major funding reductions in 1990 and 1991 may have reduced the program capability to understand basic phenomenon of the confinement and transport problems. The Subcommittee requests that the DOE assess the feasibility of retaining the Advanced Torroidal Facility on standby until it becomes clear that permanent shutdown is consistent with a prudent development strategy.

The Subcommittee authorizes DOE's FY92 budget request of $337.1 million for fusion energy programs be retained and notes that it is a minimal level to sustain the overall program.

For purposes of multi-year authorization planning, the Subcommittee authorizes $387 million for FY 1993; this amount includes $35.4 million for design work to initiate construction of the Burning Plasma Experiment Facility.

Table 18

Fusion Energy

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
Base Program	$163.2	$260
TFTR	75.3	78
ITER/EDA	41.8	47
BPX	$10.0	45

IFE	8.2	14
Capital Equipment/Construction	14.6	20
Total	$337.1	$387

The Base Program includes on-going activities in plasma science research and technology development for confinement systems.

4. Environmental Restoration and Waste Management Programs (Civilian)

Program Description

The DOE's Office of Environmental Restoration and Waste Management (EM) was created in 1989 to consolidate these activities and to better prioritize the environmental, worker, and public health issues. The civilian portion of this program is funded through Energy Supply Research and Development, which falls under the Subcommittee's jurisdiction.

The DOE weapons complex and related facilities have serious environmental problems with the attendant human health factors. Upon creation, the EM program set about to identify problems, create programs to minimize waste product, and re-educate management and workers regarding pollution and cleanup.

The Office is broken into four main groups: corrective activities to bring facilities into compliance with existing law; environmental restoration to assess and cleanup facilities and sites; waste management to minimize, treat, store and dispose of all types of radioactive and hazardous waste; and technology development to identify areas where cleanup technology is deficient and new approaches are required.

Prior to 1989, the DOE managed its environmental problems on a site by site basis, with no clear agency-wide plan. This led to difficulties in setting priorities, inconsistent managerial commitment, and resulted in competition among facilities for funds. In consolidating these activities under one department, DOE has gained control of the program and improved setting priorities and preparing a cohesive research and development plan.

Environmental and safety problems are endemic to a complex of facilities most of which were built 30 to 45 years ago under environmental and national security attitudes that were totally different from today. The legacy of that complex is a cleanup problem that may well cost more than $200 billion to correct. The current focus is to complete a characterization of the problem at a dozen or more sites some of which are as large as 560 square miles and contain hundreds of structures. At some sites there are structures and facilities that have been closed for 25 or 30 years. Understanding the magnitude and scope of the problem and setting priorities for cleanup and remediation have been the principle early goals of the program. A limited number of cleanup projects have been completed.

Table 19

Environmental Restoration and Waste Management

Funding History
($ in Millions)

Fiscal Year	Appropriation

FY89	$1,657.3*
FY90	$289.5
FY91	$437.0

*There is no breakdown for FY89 between Defense and Civilian Funds

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Table 20

Environmental Restoration and Waste Management

($ in Millions)

	FY 1991 Approp.	FY 1992 Request
Environmental Restoration and Waste Management	$437.0	$523.5

Subcommittee Recommendation

The Subcommittee supports the DOE's request and authorizes $523.5 million for FY 1992 and $594.2 million for FY 1993 to carry out the Environmental Restoration and Waste Management program at the DOE's civilian energy facilities. The Subcommittee authorizes the Department to reimburse reasonable expenditures for the characterization and remediation of Parcel 412, Oak Ridge, Tennessee, not to exceed $600,000 during FY92 from these funds.

The Subcommittee requests a report, 6 months after enactment, of all DOE (or its predecessors) previously owned property which was contaminated by activities of the Department or its predecessors which do not meet today's environmental standards. The report should describe the contaminants, cost of cleanup, current ownership, and current use.

Table 21

Environmental Restoration and Waste Management

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
Environmental Restoration and Waste Management	$523.5	$594.2

5. *Supporting Services - Policy and Management, Energy Research*

Program Description

The program provides the staffing resources and associated funding required to provide overall direction of the Office of Energy Research. In addition to directing the Office's research program, the Director of Energy Research also serves as the Department's principal science advisor for formulation of basic research policy. The FY 1992 request is $1.1 million.

Subcommittee Recommendation

The Subcommittee endorses the FY 1992 request of $1.15 million and authorizes $1.196 million for FY 1993.

B. Uranium Enrichment Research and Development

Atomic Vapor Laser Isotope Separation

Program Description

The Uranium Enrichment research and development program under the Subcommittee's sole jurisdiction is the Atomic Vapor Laser Isotope Separation (AVLIS) technology development program. The DOE's fiscal year 1992 request for this program totals $213.6 million for an increase of $59.1 million over the fiscal year 1991 appropriation of $154.5 million. Of the $213.6 million request, $204.3 million is for operating expenses, and $9.3 million is for capital equipment and construction. This compares to the breakdown of $154.5 million for fiscal year 1991 into $146.5 million for operating expenses with $8 million for capital equipment and construction.

The AVLIS research and development program goal is to develop and demonstrate a significantly less expensive method for enriching uranium. This new technology is expected to be much more economical in production and more competitive in price than the current gaseous diffusion technology which is the only process used in the United States.

The AVLIS technology uses lasers to separate vaporized uranium metal to concentrate the U-235 fissionable isotope for use as reactor fuel. The electromagnetically charged particles are collected in the separators and processed.

The AVLIS program began in 1974 and has demonstrated significant technological advancements over the life of the program. It is scheduled to complete an integrated system demonstration in FY92. The FY92 DOE requested operating budget of $204.3 million is $16.3 million over the projected request of $188 million as outlined in the January 1990 Deployment Plan. The increase is due to the closeout of the Special Isotope Separation (SIS) defense program which shared the costs for the operations of the lasers. As there is no funding for SIS in the FY92 budget, the AVLIS program must fully fund operations of the lasers.

The Deployment Plan also projected a request of $54 million for construction to perform pre-deployment, pre-construction, and design activities. The FY92 budget request includes only $3.2 million for these activities, a decrease of $50.8 million.

Table 22

Atomic Vapor Laser Isotope Separation (AVLIS)

Funding History
($ in Millions)

Fiscal Year	Appropriations

FY78	$15.6
FY79	$17.2
FY80	$19.9
FY81	$31.5
FY82	$37.0
FY83	$31.2
FY84	$103.0
FY85	$78.00
FY86	$125.6
FY87	$79.1
FY88	$89.1
FY89	$125.5
FY90	$131.4
FY91	$154.5

Table 23

Atomic Vapor Laser Isotope Separation (AVLIS)
($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
Operating	$146.5	$204.3
Capital Equipment	$5.6	$ 6.1
Construction	$2.4	$ 3.2
Total	$154.5	$213.6

Subcommittee View

The Subcommittee has strongly supported the AVLIS program and has urged a deployment as early as is practical. The Subcommittee is convinced that deployment of the technology will result in significant funds to the Treasury as a return on investment for the research and development. The Subcommittee is concerned that the economic potential of AVLIS, as well as our technological lead, will be diminished unless there is an aggressive deployment effort and unless efficient fuel cycle interfaces are demonstrated. Accordingly, the 1992 demonstration should focus on not only laser and separator demonstrations at Lawrence Livermore National Laboratory, but also emphasize, in particular, demonstration of product conversion and environmentally-safe feed preparation in prototype facilities currently being built at Oak Ridge, Tennessee. Contacts with the commercial fuel cycle industry and utilities should be maintained to ensure that maximum economic and environmental AVLIS benefits are achieved. Out of the authorized funds, the Subcommittee directs that $26.2 million of operating expenses and $1.1 million of capital equipment be authorized for the uranium processing program, as outlined in the deployment plan.

DOE planned to issue a request for proposal (RFP) for a deployment contractor in late FY90 or beginning FY91. This RFP has not been issued, and consequently much needed industrial influence and practical business acumen has not been injected into the program. The Subcommittee does not accept DOE's decision to postpone pre-deployment activities and believes the resulting delay will further jeopardize the U.S. position in the enrichment market place.

While the decision regarding construction will not be made until after the completion of the demonstration, there are certain activities which should be performed now, such as in-depth understanding of the technology by a potential plant operator; licensing activities with the Nuclear Regulatory Commission, which requires a private sector, prospective licensee; and projections of both construction and operating costs.

Table 24

Atomic Vapor Laser Isotope Separation (AVLIS)

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
Operating	$219.3	$212.8
Capital Equipment	$6.1	$8.0
Construction	$3.2	$5.0
Total	$228.6	$225.8

Therefore, the Subcommittee directs that the RFP for the deployment contractor be issued immediately and a commercial deployment contractor or private sector partner be competitively selected without delay and in place by October 1, 1991, or as soon thereafter as possible. The Subcommittee authorizes $20 million to fund selection of a commercial deployment contractor, the deployment contractor's pre-deployment activities for data analysis pending a deployment decision, and pre-application activities with the Nuclear Regulatory Commission. The $228.6 million authorization includes an additional $15 million over the budget request to assist funding for these purposes.

The deployment contractor should begin immediately to develop economic and industrial assessments appropriate to make a decision regarding deployment and/or construction. At the completion of the demonstration, the deployment contractor should prepare a report to Congress which would address economic, market, transition, and financing issues. The report would identify any problems anticipated with preliminary plant engineering or construction of a commercial AVLIS facility, contain a deployment risk assessment, and provide an evaluation of the technology. Information to accompany the final report would include operational procedures, material throughput, energy consumption, component and subsystem reliability and, most significantly, the efficiency of separation. In addition, the deployment contractor is requested to consider the deviations resulting from the less than plant-size configuration of the demonstration. The deployment contractor should also assess and encourage private sector investment into the possible commercial deployment and construction of AVLIS.

Finally, the Subcommittee is concerned that the government recoup as much of its research and development investment as is possible. To that end the DOE is directed to grant authority to its AVLIS contractors, the University of California and Martin Marietta Energy Systems, Inc., to explore, initiate and negotiate Cooperative Research and Development Agreements (CRADAs) for the purpose of finding non-uranium enrichment applications of the various AVLIS component technologies.

C. Isotope Production and Distribution

Program Direction

The Isotope Production and Distribution program is a sole jurisdiction program of the Subcommittee. In FY90, a revolving fund was created to self-finance the program and no further appropriations were required.

In its FY92 budget request, DOE is asking for a borrowing authority in the form of an $8.5 million line-of-credit, for the program to modernize some facilities and to explore new products. The line of credit would remain available until borrowed and would be repaid to the Treasury with interest with revenues from product sales.

Subcommittee View

The Subcommittee is concerned that this program needs considerable attention in order to remain a viable business entity. Furthermore, the viability of this program has significant impact on medical research, treatment, and diagnosis, as well as other research programs throughout the nation and, for some isotopes, the world. The Subcommittee will carefully investigate and examine this program and recommend direction and funding for future years.

The Subcommittee endorses the FY 92 budget request, with the stipulation that this program will be examined in depth regarding its future viability.

D. Fossil Research and Development

Program Description

The Fossil Fuels Research and Development program encompasses three major subprograms: coal, petroleum and natural gas.

Since FY 1981, the Administration's request for the Fossil Research and Development program has been consistently cutback by at least 50 percent from prior year appropriated levels. The FY 1992 request is no exception. From the FY 1991 level of $458 million the DOE has requested a 51 percent reduction to $223 million ($3 million was included in the request for the Fuels program. The Subcommittee considers the Fuels program to be a regulatory support activity and believes it should not be carried in the research and development program). In addition, the DOE has predicated their request on the transfer of $150 million from the Clean Coal Technology program to be used for Fossil Research and Development activities. The Subcommittee does not endorse the low level of funding requested for research and development activities or the transfer of the Clean Coal funding for research and development activities. The requested funding inconsistencies are presented in the following table.

Table 25

Fossil Research and Development

Funding History
($ in Millions)

FY	DOE Request	Approp.
1980	747.6	849.9
1981	1,411.5	1,134.7
1982	435.3	416.9
1983	106.9	217.5
1984	94.0	259.2

1985	202.7	274.9
1986	156.9	310.9
1987	82.8	295.9
1988	161.9	326.9
1989	166.9	380.6
1990	163.6	422.1
1991	202.3	458.8

Table 26

Fossil Research and Development
($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
Basic and Supporting Research	$206	$93
Advanced Technology Development		
MHD	40	0
Fuel Cells	43	22
Petroleum	59	52
Natural Gas	16	8
Cooperative Research and Development	12	6
Supporting Activities	84	42
Total	460	223

1. Coal Research and Development

The coal program is divided among many smaller research subprograms and also funds two major technology development efforts, one for Magnetohydrodynamics (MHD) and the other for Fuel Cells.

The coal program is predicated on three critical national needs to reduce oil imports, to meet environmental requirements, and to improve the marketability of U.S. coal technology.

(1) The need to reduce U.S. oil imports and assure a reliable electricity supply. The program assumes that the U.S. will have a continuing reliance on coal utilization for electricity generation and that reliance will increase substantially by the year 2030. The Current Policy Base assumption put forward in the National Energy Strategy (NES) assumes that consumption rises from 900 million tons of coal use today to nearly 2,600 million tons in 2030.

(2) The need to comply with existing and future environmental requirements. The physical and chemical properties of coal and the emissions of sulfur dioxide, nitrogen oxide, particulates and other impurities necessitate the development of control technologies to mitigate environmental problems. Innovative coal technologies are needed that can economically ensure environmentally acceptable levels of emissions from the utilization of the wide range of U.S. coals. Mitigation of possible global warming effects requires reduction of "greenhouse gases" particularly carbon dioxide (CO_2). Advanced coal technology development to reduce CO2 output by increasing systems efficiencies is ongoing.

(3) The need to continue to foster new ideas and to improve the marketability of U.S. coal technology and open markets for both U.S. coal and U.S. equipment in the utility, industrial, commercial and residential sectors: the availability of developed and demonstrated coal technologies that will meet environmental problems of industrialized and developing nations can give the U.S. a marketing advantage overseas. The potential also exists to export U.S. coals and U.S. coal using technologies.

The Coal Research and Development program is structured towards development of precombustion, combustion and post-combustion technologies.

Activities within the program are separated into seven subprograms of more basic and supporting research that include Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification and Surface Coal Gasification. In addition to the more basic activities, two major technologies are under development, Fuel Cells and Magnetohydrodynamics. These technology development activities are more advanced and require a larger amount of the federal share of the Coal Research and Development budget. Both technologies require a more consistent level of funding which is expected to increase.

A description of the programs, the FY 1991 funding levels, and the FY 1992 DOE requests follow.

Control Technology and Coal Preparation

The program focuses on advanced physical techniques to remove inorganic sulfur to control emissions from utility boilers. In addition, the programs of Flue Gas Cleanup, Gas Stream Cleanup and Waste Management Research and Development provide support for combustion technologies. The DOE's FY92 request for the subprogram is $22.5 million, a decrease of 60 percent from the FY91 appropriated level of $55.7 million.

Advanced Research and Technology Development (ARTD)

The program addresses specific fundamental scientific and engineering problems by supporting advanced research efforts to develop high environmental performance conversion of coal to liquid for transportation and other superclean coal use technologies. Three subprograms of Coal Utilization Science, Materials and Components and university/national laboratory coal research provide basic research support. The DOE's FY92 request for the ARTD program is $28.8 million, a decrease of 8 percent from the FY91 level of $31.3 million.

Coal Liquefaction

The goal of the program is to provide coal-based liquid fuels at around $30 per barrel by the mid-to-late 1990's. Subprograms are Advanced Research, Direct and Indirect Liquefaction, and Support Studies/Engineering Evaluations. The FY 1992 request is $17.1 million, a decrease of 60 percent from the FY 1991 level of $42.6 million.

Combustion Systems

The goal of the program is to develop innovative combustion systems that use coal more efficiently and in a more environmentally acceptable manner. The Advanced Research subprogram focuses on generic and fundamental coal research. Two subprograms directed at technology development are the Advanced Fluidized Bed and the Pressurized Fluidized Bed Technology. In the fluidized bed technology the fuel is combusted with a bed of solid particles which absorbs sulfur dioxide, turning it into a dry benign solid waste. The equipment operates at near atmospheric pressure thereby reducing the formation of NOx. The advantage of the technology is the potential for high efficiency, lower capital and operating costs, coal-type flexibility and better environmental performance. The Advanced Combustion technology subprogram emphasizes the superclean emissions control systems that will use coal and coal-based fuels to displace oil and gas. Finally, the Alternative Fuels Utilization program will establish the generic technology base for the use of coal-based slurry, liquid and solid fuels. The FY92 request is $18.6 million, a decrease of 49 percent from the FY91 level of $36.9 million.

Heat Engines

The program has supported research on overcoming the technical barriers associated with combustion, corrosion, deposition, wear and particulate control when burning dry, slurried or gaseous coal fuels in turbines and diesels. The DOE's recommendation for FY92 is to close-out this activity. The FY91 level was $23.6 million.

Underground Coal Gasification

Underground coal gasification technology converts in-situ coal to a cleaner burning gaseous fuel. The program has four major areas of emphasis: resource evaluation and characterization; process technology development; environmental impact mitigation; and technology transfer. The DOE recommends close-out of this activity in FY92. The FY91 level was $790 thousand.

Surface Coal Gasification

The program supports development of advanced coal gasification systems. The activity is comprised of five subprograms: (1) Advanced Research - fundamental research on basic coal science including systems and concepts establishing the technology base for production of hydrocarbon-based transportation fuels from coal; (2) Systems for Power Production - efforts are focused on achieving better economic and fuel conversion efficiencies for integrated gasification combined cycle systems; (3) Systems for Industrial Fuel Gas Production - efforts to find methods to improve economics for using coal-derived fuel gas in industrial processes; (4) Systems for Synthesis Gas Production - providing new and lower cost methods for producing hydrogen from coal for use in producing liquid transportation fuels through direct liquefaction; and (5) Systems for Coproducts Production - research directed toward producing the technology development needed to optimize the simultaneous production of solids, liquids and gases through use of mild gasification processes. The FY92 recommendation for the Surface Coal Gasification program is $5.3 million, a decrease of 64 percent from last year's appropriated level of $15 million.

Fuel Cells

A fuel cell is an electrochemical energy conversion device which produces electricity directly through the oxidation of a fuel. Fuel cell programs within the Fossil Research and Development budget include phosphoric acid, molten carbonate, solid oxide and other advanced systems. The fuel cells will offer significantly higher fuel conversion efficiencies, fuel flexibility, modularity, and increased environmental benefits over many conventional technologies. The DOE's research effort is to develop fuel cells using natural gas as a first fuel. Further development will use coal as a fuel.

The DOE contends that Phosphoric Acid fuel cells are nearly commercial and that no further research and development funds are required. Molten Carbonate fuel cells are at a mid-level stage of development. A broad based joint venture corporation has been established to further the technology and to develop manufacturing capability for Molten Carbonate fuel cells in the United States. The corporation consists of the Institute for Gas Technology, the Electric Power Research Institute (EPRI), utilities, manufacturers and others. The Corporation is providing 20 percent of the funding in cost-sharing the project with the DOE. The gas-using cell is anticipated to be ready for demonstration in the mid-1990s with commercial use beginning in about the year 2000.

The third technology is the solid oxide concept. A major difference between the Molten Carbonate and Solid Oxide is the electrolyte. The liquid electrolyte used in Molten Carbonate must be replenished during the operating life of the cell. The Solid Oxide cell uses a solid-state device which may simplify operation and maintenance of the cell. The solid oxide fuel cell development is a longer-term activity with anticipated commercialization in about the year 2005. The FY 1992 request of $22 million is a 48 percent decrease below the FY 1991 appropriation levels of $43 million.

Magnetohydrodynamics (MHD)

The MHD technology is based on the concept of using flowing ionized gases or liquid metals, which have been heated by a chemical fuel, as the moving conductor in an electric generator. By using the working fluid directly, the MHD generator removes the intermediate steps of generating steam and turning a turbine. Utilizing working fluids at higher temperatures than conventional powerplants can lead to increased conversion efficiencies in the 50-60 percent range as opposed to existing coal-fired plants that operate with efficiencies in the 32-35 percent range. The technology offers environmental benefits of greatly reduced emission of Sulfur Dioxide (SO_x), Nitrogen Oxide (NOx), and Carbon Dioxide (CO_2) and particulates.

The program has been funded by the DOE since 1977, although some early funding was provided by the DOE predecessor agency. P.L. 99-190, House Joint Resolution 465, Further Continuing Appropriations for FY 1986, contained language mandating cost sharing by the private sector. It is anticipated that the Proof-of-Concept stage should be complete in 1993. The DOE no longer requests funding for the project although funding has been provided through the appropriations process each year. The next stage for the technology will be demonstration, which is anticipated to cost approximately $300 million. According to testimony received by the Subcommittee, the developers intend to apply for Round Five of the Clean Coal Technology (CCT) Demonstration program. The Department did not request funding for the program in FY92.

2. Petroleum

The Petroleum Research and Development Program is divided into three components: Advanced Extraction and Process Technology; Enhanced Oil Recovery; and Oil Shale. The Advanced Extraction and Process Technology program pursues new concepts to achieve increases in efficiency and cost reduction of recovery techniques for oil, gas, oil shale, tar sands and underground coal gasification. The program provides much of the fundamental research that is relevant to oil, gas and oil shale.

The largest component of the petroleum activity is the Enhanced Oil Recovery program. The program focuses on developing advanced extraction technologies to capture additional oil left behind in reservoirs because it cannot be recovered using conventional technology. Improved reservoir characterization, analysis and field verification of reserves are also a major focus of this effort.

The Oil Shale program involves the advancement of extraction and conversion processes to convert oil shale to liquid fuels. Technology developments are focused on reducing the costs of extraction and conversion. The DOE's FY92 request is $52.1 million, a decrease from FY91 levels of 12 percent. In addition to the decrease in funding requested, the DOE also proposed to close-out ongoing research and development on Oil Shale.

3. *Natural Gas*

Unconventional Gas Recovery

The DOE has maintained a small effort on developing technologies to extract gas from unconventional sources such as lenticular tight gas sands, Eastern Devonian shales, gas hydrates, coal bed methane and deep source gas. Extracting gas from the unconventional sources are long-term efforts. The FY92 request is $8 million, a 50% decrease below FY91 appropriated levels of $16 million.

4. *Cooperative Research and Development*

The Cooperative Research and Development program was created in FY89 to provide the Federal share of support for Jointly Sponsored Research Programs (JSRP) at the Western Research Institute (WRI) and the University of North Dakota Energy and Environmental Research Center (UNDERC). Congressional direction also expanded the program to include a cost-shared agreement with the State of Illinois. The research projects receive at least 50 percent cost sharing from non-federal partners. Projects run the gamut of Fossil Research and Development research such as, oil shale process studies, tar sands research, and combustion of low rank coals. The request for Cooperative Research and Development activities for FY92 is $6.0 million, a decrease of 50 percent from the FY91 level of $11.8 million.

5. *Supporting Activities*

Within the Fossil Research and Development account there are also supporting activities of Program Direction and Management Support, Plant and Capital Equipment, and Environmental Restoration. The FY92 request of $43 million is a reduction of 50 percent below the FY91 appropriation levels.

The Subcommittee authorizes an overall level of funding for Fossil Research and Development for FY92 of $471 million, a 3 percent increase above the FY91 appropriated level of $458. For FY93 the Subcommittee authorizes $507 million. The Subcommittee authorizes the following allocation of funds for the FY92 and FY93 activities in the Fossil Research and Development program.

Table 27

Fossil Research and Development

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
Base and Supporting Research	$206	$214
Advanced Technology Development		
MHD	$41	$28
Fuel Cells	$48	$60
Petroleum	$70	$90

Natural Gas	[illegible]	[illegible]
Cooperative Research and Development	[illegible]	[illegible]
Supporting Activities	[illegible]	[illegible]
Total	[illegible]	[illegible]

Coal

For FY92 the Subcommittee authorizes the following levels. For the Basic and Supporting Research activities which includes Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification, the Subcommittee authorizes $206 million. The Subcommittee authorizes $214 million for the activities in FY93, an increase of 4 percent for inflation. In the Advanced Technology Development Activity, the Subcommittee authorizes $48 million for FY92 to fund ongoing fuel cell research and development activities; for FY93, the Subcommittee authorizes $60 million. The Subcommittee directs the Department to give priority to continuing development of Molten Carbonate and Solid Oxide Fuel Cells. A substantial financial commitment has been made to the continued development of Molten Carbonate Technology by the Department of Energy partners. It is anticipated that the non-federal commitment to Molten Carbonate fuel cell development will be approximately $300 million over the next four years. This important funding commitment by the private sector should be met by a predictable funding commitment by the federal government.

For MHD the Subcommittee authorizes $41 million for FY92 and $28 million in FY93. The Subcommittee does not endorse funding the research and development project after FY93. Approximately $650 million of federal funds have been used to develop the MHD technology. The Subcommittee has received testimony that the Proof-of-Concept will be ready in time to apply for Round Five of the Clean Coal Technology program. The Subcommittee encourages the project developers to meet the Round Five deadline and compete for demonstration funding.

Petroleum

The Administration's National Energy Strategy (NES) emphasizes increasing our domestic ability to recover oil left in reservoirs by conventional drilling techniques. Large reserves exist but need advanced technology to extract the oil. The Subcommittee believes that the $52 million requested for FY92 is inadequate to fund the needed activities and authorizes that the funding for Petroleum Research and Development be increased to $70 million in FY92. The Enhanced Oil Recovery program has the potential to provide the largest near and mid term enhancement to our energy security and a reduction in our nation's oil imports. The Subcommittee believes that the EOR potential warrants accelerating the development. The Subcommittee also believes in the need to continue a modest effort to maintain a core oil shale research and development program and does not endorse the DOE's request for close-out of the activity. For FY93 the Subcommittee authorizes $90 million for Petroleum Research and Development.

Natural Gas

The DOE is restructuring the Unconventional Natural Gas program and the budget is reduced by 50 percent to $4 million. The ongoing program, already substantially cost-shared by the private sector, will be discontinued. The DOE plans to only fund cost-shared projects. The Subcommittee believes that the goals of the Unconventional Gas Recovery program as stated in the budget submission are undefined. In 1990 the DOE submitted to Congress a Gas Research Program Plan that provided guidance for a time-phased, national research and development strategy to provide a basis for greater utilization of the nation's natural gas resources. The five year plan called for expenditures for FY92 of $24 million and for FY93 of $25.4 million. The Subcommittee does not agree with the proposed program reorganization and urges the DOE to continue its current activities to their logical conclusion. In addition the Subcommittee authorizes that the funding for FY92 be increased to $23 million and for FY93 authorizes $26 million.

It is the Subcommittee's opinion that joint programs with industry involving cost sharing and other resource commitments by all the parties, carries with it obligations to be a responsible partner. In such cases, major program changes should only be made after consultations with the parties involved.

Cooperative Research and Development

For FY92 the Subcommittee endorses the Department's request of $6 million. For FY93 the Subcommittee authorizes $7 million to continue activities.

Supporting Activities

For the Supporting Activities of Program Direction and Management Support, Plant and Capital Equipment and Environmental Restoration, the Subcommittee authorizes $77 million for FY92 and $82 million for FY93. The increase above the request of $42 million reflects the programmatic increases proposed by the Subcommittee.

Fossil Research and Development Cost-Sharing

The FY 1992 DOE budget request for Fossil Research and Development includes a greater emphasis on private sector cost-sharing. The Subcommittee believes that the recent emphasis on cost-sharing for even the smallest project is budget driven. The Subcommittee is concerned that smaller companies who have established research integrity will be precluded from participating in the federal program for lack of early capital investment. In prior years the Subcommittee has endorsed the concept of cost sharing of appropriate projects such as Clean Coal Technologies or specific project joint ventures to leverage scarce research dollars.

The Subcommittee is concerned that the increased application of cost-sharing is proceeding without careful consideration of its consequences. Therefore, the Subcommittee directs that the DOE establish appropriate guidelines for cost-sharing that consider the nature of the project (basic research, technology development or technology demonstration), the costs for completion, and the appropriateness of cost-sharing for the particular research and development endeavor. In addition, the DOE should establish a process for timely approval that will allow industry to begin the proposed cost-shared research in a timely manner. The Subcommittee recommends that the DOE consider different levels of private sector cost-sharing depending on the scope and cost of the project. Finally, the DOE should include in the guidelines provisions governing the use of data, rights, and ownership of the research results or technologies developed. Results of the study should be provided to the Subcommittee upon completion.

The Subcommittee is concerned that the DOE, in its efforts to obtain funding, is losing sight of the basic objectives of the research and development programs and that of cost sharing. Cost-sharing can be an effective and useful addition to the DOE's research and development programs in that it provides a clear indication of commercial interest, but it must be used thoughtfully and appropriately to achieve the desired objectives.

V. GENERAL POLICY GUIDELINES

A. Construction of Major Research and Development Facilities

One objective of the Subcommittee is to provide authorizations to support essential major research and development facilities at the least capital cost to the government. For purposes of this Act two classes of construction projects have been specified. Substantial construction projects for research and development facilities are those for which the estimated cost of construction exceeds $10 million but is less than $100 million. Major construction projects are those for which the estimated cost of construction exceeds $100 million. The estimated cost shall include all experimental equipment to be installed such as accelerators, complete with controls, supporting equipment and utilities.

The Subcommittee requires that each Substantial Construction Project must be authorized in its entirety prior to the start of construction. The Subcommittee believes that the long term implications of both total project costs to build research and development facilities and commitments to additional operating costs to run such facilities must be carefully weighed before funding is provided to start construction. The building of a major facility includes planning, design, construction, emplacement of heavy equipment, installation, checkout, and testing ready for initial use.

Regarding major construction projects, the Subcommittee is concerned about three primary problems in the way DOE facilities are authorized, constructed, and made ready for operation. The first problem relates to the lack of accurate data to support authorization decisions. The second problem relates to the orderly conduct (continuity) of the project. The third problem relates to an annual appraisal by the DOE with "Estimate to Complete Data" furnished yearly to the Congress in the form of following year projections. Such appraisals shall be included in annual budget requests. Accordingly, the Subcommittee directs the following actions for FY92 with the expectation of repeating these requirements in subsequent years.

(1) All Major Construction Projects Research and Development Facilities shall include the following phases:

(a) Conceptual Planning. This phase should to the extent possible, include all supporting facilities such as electric power, water, sewer, communications, etc. The most important aspect of this planning stage is the substantiation of the absolute need for the proposed facility. Meetings and discussions among members of the research community and representatives of the DOE are to cover the potential benefits of the intended research in relation to other possible experiments and research performed at a different kind of facility which could be more beneficial to the public. The merits of the proposed facility compared to other new facility options is to be covered in detail in a report to Congress. That report is to be submitted along with the next annual budget request after the initiation of conceptual planning. Conceptual planning is not to include any reference to specific site locations.

(b) Title I, Conceptual Design. This phase must include engineering personnel familiar with the type of facility to be constructed. Engineers will work closely with user groups to further define the facility requirements and make rough cost estimates for building the complete facility, including all instrumentation. No cost estimates will take credit or make allowances for contributions by industry, state, or foreign governments or any other body.

(c) Title II, Preliminary Design. At this stage, additional design detail will be provided in the form of preliminary drawings and specifications made by engineers and reviewed and approved by user groups. Again, no reference is to be made to any specific site locations for the facility. Site locations will only be considered in Title III activities. In addition, a unit price estimate of the total project cost shall be made to support further continuance with the project. (A unit price cost estimate is one made by allowing so much for a unit of material in place. For example, $125 per cubic yard of reinforced concrete.) Again, no allowances will be made for "outside" contributions. Finally, when necessitated by the nature of the facility and/or its use, Title II shall also include a complete Environmental Assessment or Environmental Impact Statement as required by law or as needed in the opinion of the DOE. Finally, and in addition to the estimate for final design and construction of facilities, a complete, detailed operating cost estimate by year covering the intended useful operating life of the research is to be furnished before funds will be authorized for final design and construction. This estimate is to be prepared by the research community and approved by the DOE. It shall include scientific personnel, technicians, operations and maintenance personnel, office personnel, utility costs, supplies, supporting equipment and other expenses. This estimate will not only be used by the Congress to render a sound judgement in deliberating over authorizations, but could be used as an upper ceiling on future year authorizations. This estimate will also identify any offset associated with facilities that would be closed out by the proposed facility.

(d) Title III, Final Design: Final design includes site selection, general specifications, shop drawings, and equipment detail specifications, complete and ready for construction to be performed. Title III also shall include detailed cost estimates made on a "time and material" basis prepared by professional engineering estimators with supporting substantiation in the form of subcontractor quotations. These detailed estimates shall be based on a specific location.

(e) Title IV, Construction: The activities related to the physical construction of the facility, including land acquisition and site preparations.

(2) The Subcommittee recognizes that in the past the DOE may have defined the above referenced "Titles I through IV" somewhat differently. Nonetheless, the Subcommittee has based its position on the definitions presented above.

(3) The Subcommittee strongly believes the Federal budget situation is such that the government can no longer afford to embark on vast projects only to discover, at some later point in time, the cost to be more than can be afforded. At that time, the project can be abandoned or changed in scope only at great loss to the government. Therefore, it is imperative that the project cost be estimated accurately, to the extent possible, before full authorization is made. The Subcommittee recognizes this concept could, in certain circumstances, result in some additional cost to projects as a result of a delay in starting construction. However, this additional cost is considered to be significantly less than that which is frequently incurred by initiating projects before they are well defined.

(4) The Subcommittee, in taking this action, will authorize Major Construction Projects for research and development facilities in two steps. The first step will provide for "Conceptual Planning, Title I, and Title II". It will not provide for Title III, land acquisition, long-lead procurement or any physical construction. The second step in authorizing such facilities will be based on a Congressional evaluation of the merits of each Major Research and Development Facility relative to the estimated cost and absolute need for such facilities. The first step will be authorized in response to a

budget request from the DOE which identifies the full scope of the project, the need for the facility, the amount of the authorization needed for the first step, and the date of completion of Step 1.

Step 2 will not be authorized unless and until the DOE submits complete detailed cost estimates prepared in Step 1. These estimates shall include all costs (including design, construction, and operation for a specific period), schedules, personnel requirements, and a management plan. When necessary, because of the nature of the facility, a complete detailed Environmental Assessment or Environmental Impact Statement shall be submitted with the estimates, plans, statement of need, and contingencies related to the facility. This information must be submitted with the budget request.

(5) The Subcommittee is equally concerned about the orderly conduct of Major Research and Development Facilities from the standpoint of optimizing design and construction schedules in order to minimize cost. The Subcommittee is aware of the detrimental impact the annual budget process has on large capital-intensive projects. Not only is project management made more complicated, but subcontracts often have to be changed to accommodate project funding. These changes almost always result in additional cost without benefit to the government. Therefore, as a matter of policy, the Subcommittee will endeavor to authorize funding for Major Research and Development Facilities as far in advance as possible. In this regard, the Subcommittee may introduce legislation to provide for full authorization of Title III in "no-year-money".

(6) The Subcommittee is also concerned about the vigilance and timely reporting of progress and problems on Major Research and Development Facility projects. Recognizing the DOE's responsibility to oversee such projects if not actually manage them, the Subcommittee expects the DOE to be fully aware of actual expenditures and commitments relative to planned expenditures and commitments, as well as actual progress, at all times. Therefore, the Subcommittee directs the DOE to provide such information as may be required for all "ongoing" Major Research and Development Facilities in FY92 by including them in its budget request for FY93. At a minimum, the DOE is to furnish milestone progress schedules showing actual progress versus planned and financial schedules showing actual expenditures versus planned for each and every active Major Construction Projects for a research and development facility. This information is to include complete outyear estimates through project completion.

Two prospective major construction projects are currently undergoing Preliminary Design Activity and are planned to enter formal construction status in FY93. Both of the projects, the Advanced Neutron Source (ANS) and the Burning Plasma Experiment (BPX) have undergone extensive conceptual design work, safety analysis and other activities related to siting and construction. The Subcommittee recognizes that it would be difficult at this time to adapt these two projects to the procedures spelled out above. Therefore, it is the Subcommittee's intent that both of these projects be excluded from the letter of the law in terms of reporting and approval schedules and requirements. However, the Subcommittee believes it is equally important that they follow the "spirit of the law". Therefore, the DOE should provide as soon as practical after completion of the Title II, Preliminary Design Activity for both projects, the equivalent information including total project costs, schedules and commitments for operating costs. The DOE should likewise identify any facilities to be closed out as a result of the availability of the new facilities.

B. Fast Flux Test Facility Research Reactor User Complex

The Subcommittee fully supports the establishment of the FFTF as a multi-mission research and development center (Research Reactor User Complex (RRC)) which will be operated by the DOE in partnership with international and domestic user organizations.

The Subcommittee supports authorizing agreements between DOE and non-Federal entities (which includes foreign governments, and other entities) or a consortium of such entities to use the FFTF RRC for: (1) the production of industrial and medical isotopes; (2) irradiation services which supports research and commercialization objectives; and (3) production of steam.

The establishment of the FFTF RRC by DOE should take place within 90 days of enactment. Agreements between DOE and non-federal entities, including foreign governments and entities, is authorized. DOE is also provided with authority to assess necessary or appropriate charges from the non-Federal entities and to make agreements with the non-Federal entities for no more than 25 years.

C. Annual Budget Submission

The Subcommittee is concerned that the current one year budget submissions by the agency provides an inadequate basis for assessing research and development programs or providing policy or authorizing guidance. Most research and development projects for energy technologies require several years and, in some cases, decades from concept to commercialization. The current practice of overseeing these programs and projects on the basis of a one year budget leads to judgements based on wholly inadequate information. Commitments are often made with little understanding of the outyear costs or payoffs.

The Subcommittee believes that both the agency and the Congress need a better basis for evaluation and decision making. The funding constraints under which both the agency and Congress must operate for the foreseeable future necessitate a more thoughtful, better informed approach. This is particularly relevant to research and development programs.

The Subcommittee, therefore, shall require that the Secretary of Energy provide to the Congress annually a three year budget for the programs under the Committee's jurisdiction. These programs are: Energy Supply Research and Development; General Science and Research; Uranium Enrichment; Isotope Production and Distribution Fund; Nuclear Wate Fund; Departmental Administration; Fossil Energy Research and Development; Clean Coal Technology; and Energy Conservation Research and Development. It is recognized by the Subcommittee that the outyear estimate may change significantly, nevertheless, the best available estimate at the time of budget preparations provides for intelligent assessment based on the best available information at that time.

D. Authorization Restriction

Program Authorization Provision

The Subcommittee believes that the selection and funding of projects without the authorizing legislation in place is a widespread practice and one that should be discouraged. The obligation of scarce federal funds to projects that have not been authorized may severely impact the direction, guidance, and funding levels provided by appropriate authorizing procedures and may lead to wasteful government spending.

SECTION-BY-SECTION

ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT AUTHORIZATION ACT OF 1991

SEC. 1. Short Title: Energy Technology Research and Development Authorization Act of 1991

SEC. 2. Findings.

SEC. 3. Definitions.

SEC. 4. Authorization of Appropriations

1. Under Supporting Research and Technical Analyses:

   A. Basic Energy Sciences:

      1. FY 1992: The Basic Energy Sciences Program authorizes $714.7 million which includes:
         a. $6.3 million to complete construction of the Advanced Light Source;
         b. $90.4 million for construction of the Advanced Photon Source
      2. FY 1993: The Basic Energy Sciences Program authorizes $836.5 million which includes:
         a. $437.6 million for research and development;
         b. $196.0 million for User Facility Operations;
         c. $112.6 million for construction of the Advanced Photon Source; and
         d. $38.9 million for construction of the Advanced Neutron Source.
      3. In addition, $93 million for FY 1994 and $45 million for completion of the construction of the Advanced Photon Source.

   B. Energy Research Analyses Program: $4.0 million in FY 1992 and $4.2 million in FY 1993.

   C. Multiprogram Energy Laboratory Facilities Support: $23.9 million for FY 1992 and $24.9 million for FY 1993.

   D. University and Science Education: $57.5 million in FY 1992 and $72.9 million for FY 1993.

   E. Advisory and Oversight, Program Direction and Policy Management: $10.1 million in FY 1992 and $10.5 million in FY 1993.

2. Nuclear Energy

   A. Nuclear Energy Research and Development Program:

      1. Certification of Light Water Reactor Designs: $44.5 million for FY 1992 and $62.5 million for FY 1993.

2. First-of-a-Kind Engineering: $2.0 million for FY 1992 and $20.0 million for FY 1993.
3. Advanced Reactors Research and Development: $60.5 million for FY 1992 and $73.0 million for FY 1993.
4. Space Reactor Power Systems: $36.0 million for FY 1992 and $36.5 million for FY 1993.
5. Advanced Radioisotope Power: $56.0 million for FY 1992 and $58.0 million for FY 1993.
6. Space Exploration Initiative: $5 million in FY 1992 and $5.0 million for FY 1993.
7. Facilities Support for FY 1992 of $178.8 million of which $79.0 million is for the Fast Flux Test Facility; and $168.8 million for FY 1993, of which $69.0 million is for the FFTF.
8. Program Direction, Nuclear Energy: $10.2 million for FY 1992 and $16.2 million for FY 1993.

B. For conducting research and development to explore new technology for mitigating hazards associated with civilian nuclear waste: $8.0 million authorized for FY 1992 and $8.32 million for FY 1993.

3. Fusion Energy Research and Development

A. Magnetic Fusion Energy Research:
   a. $328.9 million for FY 1992; this includes $30.0 million for preconstruction for the Burning Plasma Experiment Facility;
   b. $41.8 million for Engineering Design Activity of the International Thermonuclear Engineering Reactor;
   c. for FY 1993, $387.0 million.

B. Inertial Confinement Fusion Program: $8.2 million for FY 1992 and $14.0 million for FY 1993.

4. Atomic Vapor Laser Isotope Separation Program:

A. $228.6 million for FY 1992 of which $219.3 million is for Operations to include $20.0 million for a commercial deployment contractor.

B. $225.8 million is authorized for FY 1993 for AVLIS.

5. Environmental Restoration and Waste Management Program for Civilian Energy Programs: $523.0 million is authorized for FY 1992 and $594.2 million for FY 1993.

6. Fossil Energy

A. The authorization for FY 1992 is $471 million which includes $206 million for Basic and Supporting Research

1. $89 million for Advanced Technology Development of which $48 million is for fuel cells and $41 million for Magnetohydrodynamics.
2. $70 million for Petroleum Research and Development.
3. $23 million for Natural Gas.
4. $6 million for Cooperative Research and Development

5. $77 million for Supporting Activities, including Program Direction, Environmental Restoration and Plant and Capital Equipment.

B. $507 million for FY 1993 which includes:

1. $214 million for Basic and Supporting Research
2. $88 million for Advanced Technology Development, including $60 million for fuel cells and $28 million for Magnetohydrodynamics.
3. $90 million for Petroleum.
4. $26 million for Natural Gas.
5. $7 million for Cooperative R&D.
6. $82 million for Supporting Activities.

SEC. 5. Major Construction Policy

A. It shall be the policy that substantial construction projects (defined as those over $10 million but less than $100 million TCC) for civilian energy R&D facilities shall be authorized for the life of the construction.

1. With respect to Major Construction Projects (over $100 million) shall be authorized for the life of construction upon the completion of the preliminary design phase and after Congress has been provided schedule and cost estimates.

SEC. 6. Advanced Neutron Source and Burning Plasma Experiment Major Construction Projects: the Secretary will report to the Congress anticipated cost and schedule information after the completion of the Preliminary Design for consideration by the Congress of complete project authorization.

SEC. 7. Atomic Vapor Laser Isotope Separation.

A. Deployment contractor participating in the demonstration program shall be secured in an expeditious manner.

B. Laboratories responsible for development are authorized to enter into cooperative research and development agreements to identify non-uranium enrichment applications of the technology to the private sector.

SEC. 8. Standardized Commercial Nuclear Powerplant.

A. The Secretary shall award a contract for First-of-a-Kind Engineering only for designs certified by the Nuclear Regulatory Commission.

B. Stipulates that the plant be built in the United States and that there be a binding agreement for construction of a nuclear powerplant of at least 600 mw.

C. At least 50 percent of funding shall be from non-Federal sources; Federal contributions shall not exceed $20 million each year or a total of $60 million.

SEC. 9. Historically Black Colleges and Universities: Requires the Secretary to provide to

Congress a plan to increase participation by HBCU in the Department Basic Energy Sciences Program.

SEC. 10. Research Reactor User Complex.

A. Purpose - to establish the Fast Flux Test Facility as a multi-mission center for R&D to be operated by DOE in partnership with international and domestic users.

B. Authorized the DOE or operating contractor to enter into agreements with non-federal entities.

C. Charges shall be set by the Secretary as appropriate.

D. Under any agreement the DOE may include a termination provision that requires DOE to pay for the unamortized balance of any special facilities of non-federal entities and stipulates the applicable provisions.

E. RRC Fund shall be established in the Treasury for revenues and expenditures shall be subject to Appropriations.

SEC. 11. Annual Budget Submission. Requires the Secretary shall annually submit to the Congress a three year budget estimate for Civilian Research and Development programs of the Department of Energy.

SEC. 12. Authorization Restrictions. Provide that:

1. No amount appropriated pursuant to this Act may be used for any program request in the budget but for which authorization is declined.
2. No amount appropriated pursuant to this Act may be used for any program in excess of the amount authorized.

SUBCOMMITTEE ON ENERGY
DEPARTMENT OF ENERGY AUTHORIZATION
SUMMARY TABLE
(DOLLARS IN MILLIONS)

PROGRAM	FY 1991 APPROPRIATION	FY 1992 REQUEST	FY 1992 RECOMMENDATION	FY 1993 RECOMMENDATION
Energy Supply R&D:				
Supporting Research and Technical Analysis				
Basic Energy Sciences	711.8	714.7	714.7	836.5
Energy Research Analyses	3.7	4.0	4.0	4.2
Multiprogram Laboratory Facilities	23.6	23.9	23.9	24.9
University and Science Education	46.6	43.9	57.5	72.9
Advisory and Oversight	4.2	10.1	10.1	10.5
Nuclear Energy Research and Development	305.8	398.0	391.0	420.0
Civilian Radioactive Waste Research and Development	.7	.7	8.0	8.3
Fusion Energy Research and Development	298	337.1	337.1	387
Supporting Services (Policy and Management - Energy Research)	.8	1.2	1.2	1.2
Environmental Restoration and Waste Management (Civilian)	437.0	523.5	523.5	594.2
Total, Energy Supply Research and Development	1,832.2	2,062.1	2,071	2,359.7
Uranium Enrichment				
Atomic Vapor Laser Isotope Separation (AVLIS)	154.5	213.6	228.6	225.8
Fossil Energy Research and Development	458.0	227	471	507
Total, Science, Space, and Technology Jurisdiction	2,444.7	2,502.7	2,770.6	3,092.5

Mrs. **Lloyd**. The Chair now recognizes Mr. Murray for discussion and an explanation of the bill.

Mr. **Murray**. Thank you, Madam Chairman.

Before proceeding with a brief summary of the section by section, I would like to call attention to two aspects of the bill that I think are important—policy recommendations designed to provide better information to the members of the Committee for making decisions on construction investments, and also for establishing priorities.

One policy recommendation addresses major construction projects. It requires that essential cost and schedule information be provided at the critical time in the construction decision process for evaluation from the Congress. A decision, up or down, regarding the authorization of the entire construction project would then be made prior to the start of physical construction. This may appear somewhat revolutionary, but I assure you, no successful business would make a major investment without such a process.

The second policy recommendation requires a 3-year budget forecast for energy research and development programs, and for major products. In most energy technology development efforts, 3 years does not cover the time from concept to development. Nevertheless, a 3-year budget forecast will at least provide a basis to understand and appreciate the commitments required in seeing these projects through the research, development, and demonstration cycle. We believe this will be helpful in assessing priorities and in understanding the necessity for choices in a timely manner.

With that introduction, let me very briefly go through the section by section on the bill.

Sections one, two, and three deal with the title, findings and definitions, respectively. Section four addresses the authorization of appropriation. Under this section, the basic energy sciences program is funded at $714.7 million for fiscal year 1992. Included within that are $6.3 million for completion of the advanced light source construction project and $90.4 million for continued construction of the advanced photon source.

For fiscal year 1993, the basic energy sciences program is authorized at $836.5 million. This includes funding for the continuation of construction of the advanced photon source of $112.5 million, and also $38.9 million for the initiation of construction for the advanced neutron source.

The bill also provides funding for fiscal years 1994 and 1995 for the completion of the advanced photon source of $93 million and $45 million respectively.

The bill supports the continuation of energy research analysis, the multi-lab facilities program, and oversight and advisory activities of the Department under the basic energy sciences. It provides for university and science education of $57.5 million in fiscal year 1992, and $72.9 million in fiscal year 1993.

Nuclear energy program specifies funding for specific major subprogram elements, including the light water reactor designs program of $44.5 million and $62.5 million for fiscal years 1992 and 1993, respectively. The first-of-the-kind engineering program, which is included within the light water program, is funded for $2 million in fiscal year 1992 and $20 million in fiscal year 1993. The advanced reactor research and development program is proposed for

$60.5 million in fiscal year 1992 and $73 million for fiscal year 1993.

Space power systems program is recommended for $36 million for fiscal year 1992 and $36.5 million for fiscal year 1993. The advanced radio isotopes program is recommended for $56 million in fiscal year 1992 and $58 million in fiscal year 1993.

Space exploration initiative is recommended for $5 million in fiscal year 1992 and $5 million in fiscal year 1993. The facilities support provided in fiscal year 1992 at $178.8 million, which includes $79 million for the Fast Flux Test Facility and is recommended for $168.8 million in fiscal year 1993, of which $69 million would be for the FFTF program. Program direction and support is also provided.

Also $8 million is provided for a research and development program for civilian nuclear waste in fiscal year 1992 and $8.3 in fiscal year 1993. The fusion energy program request is supported for fiscal year 1992 at $328.9 million for magnetic fusion, and $387 million for fiscal year 1993. The inertial confinement program is supported at $8.2 million in fiscal year 1992 and $14 million in fiscal year 1993.

The atomic vapor laser isotope separation program is recommended for $228.6 million in fiscal year 1992—and $219.3 million of that for operations, $20 million for a commercial deployment contract—$225.8 million is recommended for fiscal year 1993. Environmental restoration and waste management program is recommended for $523 million in fiscal year 1992 and $594.2 million in fiscal year 1993.

The fossil energy program is authorized at $471 million for fiscal year 1992, of which $89 million is for advanced technology development, $48 million of which is for the fuel sales program and $41 million for the Magneto Hydrodynamic program. Then $70 million is provided for petroleum research and development in fiscal year 1992; $23 million for natural gas; $6 million for cooperative research and development; and $77 million for supporting research activities.

For fiscal year 1993, $507 million is recommended for fossil research and development, and a break down is provided, including $90 million for petroleum and $26 million for natural gas.

Section five addresses major construction policy. It requires that major construction projects and substantial construction projects be authorized in their entirety at the start of construction and provides conditions under which that would occur and the information to be provided.

Section six identifies the advanced neutron source and the burning plasma experiment. Major construction projects that are in process and requires the Secretary report the anticipated cost and schedule information at the completion of preliminary design for review and consideration has an authorization by the Congress.

Section seven addresses the advanced vapor laser isotope separation. This expeditiously requires the securing of a deployment contractor and provides authority for the research and development laboratories to participate in cooperative research and the development of agreements to transfer this technology to the private sector.

Standardization of commercial nuclear power plants is provided for in Section eight. This specifies the conditions for award of first-of-a-kind engineering design awards.

Section nine addresses historically black colleges and universities and their participation in the basic energy sciences program and requires the Secretary to provide for Congress a plan for such participation.

Section 10 provides for a research reactor, user complex, and establishes the fast flux test facility as a multi-mission center for research and development to be operated by the DOE in partnership with international and domestic users. It specifies criteria and stipulations for such operation.

Section 11 addresses the annual budget submission and requires the Secretary to submit 3-year budget estimates for civilian R&D programs.

Section 12 provides authorization restrictions and provides that no amount appropriated pursuant to this act may be used for any program request in the budget for which authorization declined and also no amount exceeding that in the authorization be authorized for the program.

That's it.

Mrs. LLOYD. Thank you very much, Mr. Murray.

Is there any further discussion on the bill at this time?

[No response.]

Mrs. LLOYD. If not, the bill is now open.

Before the amendment, I understand that my amendment is before the members. I would like to offer the justification for the en bloc amendment.

During the drafting of our bill, errors were made that make it necessary for me to offer the en bloc amendment before you. Most errors are structural, such as adding a total funding amount for nuclear energy that was amended.

In addition to the first-of-a-kind engineering program, it is a sub program of the advanced reactor program, and not a stand alone item, as it's currently shown in our draft bill. Because the first-of-a-kind engineering program is listed separately, it was double counted in the advanced reactor funding. My amendment makes the proper adjustments to that account by subtracting the funding. I can assure the members that—accept three items in the amendment—the changes reflect a refinement of the original package.

If any confusion exists with the amendment, please do not hesitate to discuss your concerns.

I would like to mention three other items that are included in the amendment. The first is on page three, line four. The fiscal year 1993 funding level for the advanced photon source was miscalculated and the proper number has been included. The second item is on page six line 25, a line item for funding to be in construction of the burning plasma experiment facility has been added. The funding level is already included in the prior package.

Finally, we've added a new section, section 11, that asks the Department of Energy to formulate guidelines for appropriate cost sharing in a fossil research and development program and report to Congress on these guidelines within 6 months after enactment of the bill.

[The en bloc amendments offered by Mrs. Lloyd follow:]

LLOYD030

AMENDMENTS TO THE SUBCOMMITTEE DRAFT
OFFERED BY MRS. LLOYD

Page 3, line 24, strike ``$120,500,000'' and insert in lieu thereof ``$112,500,000''.

Page 4, line 24, insert ``, $391,000,000 for fiscal year 1992, and $420,000,000 for fiscal year 1993, including'' after ``Development Program''.

Page 4, line 25, through page 5, line 2, amend clause (i) to read as follows:

(i) Certification of Light Water Reactor Designs, $44,500,000, for fiscal year 1992, of which $2,000,000 shall be for first-of-a-kind engineering for initiating the first standardized commercial nuclear power plant, and $62,500,000 for fiscal year 1993, of which $20,000,000 shall be for first-of-a-kind engineering for initiating the first standardized commercial nuclear power plant;

Page 5, lines 3 through 6, strike clause (ii), and redesignate subsequent clauses accordingly.

Page 6, line 25, insert '', of which $35,400,000 shall be for construction of the Burning Plasma Experiment facility'' after ''fiscal year 1993''.

Page 17, after line 3, insert the following new section:

SEC. 11. COST SHARING GUIDELINES.

The Secretary shall conduct a study of the appropriateness of cost sharing requirements for fossil research and development projects of the Department of Energy, taking into account the type of project and costs required for completion. Within 6 months after the date of enactment of this Act, the Secretary shall submit to the Congress a report containing the results of such study, along with proposed guidelines for cost sharing with respect to such projects, including provisions regarding the use of data, rights of parties, and ownership of the research results or technologies developed.

Redesignate subsequent sections accordingly.

LLOYD016

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SUBCOMMITTEE DRAFT

102D CONGRESS
1ST SESSION

H. R. ___

IN THE HOUSE OF REPRESENTATIVES

Mrs. LLOYD introduced the following bill; which was referred to the Committee on ____________

A BILL

To authorize appropriations for research and development and demonstration activities of the Department of Energy for fiscal years 1992 and 1993, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ``Energy Technology Research and Development Authorization Act of 1991''.

SEC. 2. FINDINGS.

The Congress finds that--

(1) the development of new energy technologies is a necessary step in reducing oil imports and providing for our Nation's energy needs in the 21st century;

(2) the development of efficient, economic, safe, and environmentally acceptable energy technologies is a necessary part of an effective National Energy Strategy;

(3) technological advances in the recovery and use of our fossil fuel resources will provide time for an orderly transition to other energy sources while at the same time reducing our vulnerability to supply disruptions, price escalations, and the environmental side effects of fossil fuel use; and

(4) technology development occurs over a time span that is often measured in years or even decades, therefore, commitments to new energy technology development must be consistent with those time requirements and cannot be made on a year-to-year basis.

SEC. 3. DEFINITIONS.

For purposes of this Act--

(1) the term ``major construction project'' means a project whose construction costs are estimated to exceed $100,000,000 over the life of the project;

(2) the term ``Secretary'' means the Secretary of Energy; and

(3) the term ``substantial construction project'' means a project whose construction costs are estimated to exceed $10,000,000, but not to exceed $100,000,000, over the life of the project;

SEC. 4. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary the following amounts:

(1) Supporting Research and Technical Analysis--

(A) Basic Energy Sciences Program--

(i) $714,700,000 for fiscal year 1992, of which $6,300,000 shall be for completion of construction of the Advanced Light Source and $90,400,000 shall be for construction of the Advanced Photon Source;

(ii) $836,500,000 for operating, capital equipment, and construction for fiscal year 1993, of which $437,600,000 shall be for research activities, $196,000,000 shall be for the operation of user facilities, $120,500,000 shall be for construction of the Advanced Photon

Source, and $38,900,000 shall be for construction of the Advanced Neutron Source;

(iii) $93,000,000 for fiscal year 1994 shall be for construction of the Advanced Photon Source; and

(iv) $45,000,000 for fiscal year 1995 shall be for completion of the construction of the Advanced Photon Source;

(B) Energy Research Analysis Program, $4,000,000 for fiscal year 1992, and $4,200,000 for fiscal year 1993;

(C) Multiprogram Energy Laboratories Facilities Support program, $23,900,000 for fiscal year 1992, and $24,900,000 for fiscal year 1993;

(D) University and Science Education, $57,500,000 for fiscal year 1992, and $72,900,000 for fiscal year 1993; and

(E) Advisory and Oversight Program Direction and Policy Management for Energy Research activities, $10,100,000 for fiscal year 1992, and $10,500,000 for fiscal year 1993.

(2) Nuclear Energy--

(A) Nuclear Energy Research and Development Program--

(i) Certification of Light Water Reactor

Designs, $44,500,000 for fiscal year 1992, and $62,500,000 for fiscal year 1993;

(ii) First-of-a-kind engineering for initiating the first standardized commercial nuclear power plant, $2,000,000 for fiscal year 1992, and $20,000,000 for fiscal year 1993.

(iii) Advanced Reactor Research and Development, $60,500,000 for fiscal year 1992, and $73,000,000 for fiscal year 1993;

(iv) Space Reactor Power Systems, $36,000,000 for fiscal year 1992, and $36,500,000 for fiscal year 1993;

(v) Advanced Radioiscotope Power, $56,000,000 for fiscal year 1992, and $58,000,000 for fiscal year 1993;

(vi) Space Exploration Initiative, $5,000,000 for fiscal year 1992, and $5,000,000 for fiscal year 1993;

(vii) Facilities Support, including operations, capital equipment, and general plant construction, $178,800,000 for fiscal year 1992, of which $79,000,000 shall be for the Fast Flux Test Facility, and $168,800,000 for fiscal year 1993, of which $69,000,000 shall be for the Fast Flux Test Facility; and

(viii) Program Direction, Nuclear Energy, $10,200,000 for fiscal year 1992, and $16,200,000 for fiscal year 1993; and

(B) For developing and conducting an integrated research and development program to explore new technologies for reducing, treating, transmuting, separating, recycling, storing, or otherwise mitigating hazards associated with high level radioactive waste and spent fuel from nuclear reactors, $8,000,000 for fiscal year 1992, and $8,320,000 for fiscal year 1993.

(3) Fusion Energy Research and Development--

(A) Magnetic Fusion Energy Research, including operating activities, program direction, capital equipment, and construction activity--

(i) 328,900,000 ~~$329,600,000~~ for fiscal year 1992, of which--

(I) $30,000,000 ~~$35,400,000~~ shall be for pre construction activities of the Burning Plasma Experiment facility; and

(II) $41,800,000 shall be for the Engineering Design Activity of the International Thermonuclear Engineering Reactor; and

(ii) $387,000,000 for fiscal year 1993; and

(B) Inertial Confinement Fusion Program, $~~7,500,000~~ $8,200,000 for fiscal year 1992, and $14,000,000 for fiscal year 1993.

(4) Atomic Vapor Laser Isotope Separation Program--

(A) $228,600,000 for fiscal year 1992, of which--

(i) $219,300,000 shall be for operations, including $20,000,000 for procurement of a commercial deployment contractor and a predeployment assessment of the demonstration of Atomic Vapor Laser Isotope Separation technology and the preparation of a report to the Congress, to be submitted within 90 days after completion of such demonstration, on the economic market, financing, and risk assessment for commercial deployment of such technology;

(ii) $6,100,000 shall be for capital equipment; and

(iii) $3,200,000 shall be for construction; and

(B) $225,800,000 for fiscal year 1993.

(5) Environmental Restoration and Waste Management Program, for corrective activities, environmental restoration, waste management, and related technology development for civilian programs and activities of the Department of Energy, $523,500,000 for fiscal year 1992,

and $594,200,000 for fiscal year 1993.

(6) Fossil energy--

(A) $471,000,000 for fiscal year 1992, of which--

(i) $206,000,000 shall be for Basic and Supporting Research, including Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification, and Surface Coal Gasification;

(ii) $89,000,000 shall be for Advanced Technology Development, including $48,000,000 for Fuel Cells, and $41,000,000 for M~~e~~agnetohydrodynamics;

(iii) $70,000,000 shall be for Petroleum;

(iv) $23,000,000 shall be for Natural Gas;

(v) $6,000,000 shall be for Cooperative Research and Development; and

(vi) $77,000,000 shall be for Supporting Activities, including Program Direction and Management Support, Environmental Restoration, [redacted], and Plant and Capital Equipment; and

(B) $507,000,000 for fiscal year 1993, of which--

(i) $214,000,000 shall be for Basic and Supporting Research, including Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification, and Surface Coal Gasification;

(ii) $88,000,000 shall be for Advanced Technology Development, including $60,000,000 for Fuel Cells, and $28,000,000 for M~~e~~agnetohydrodynamics;

(iii) $90,000,000 shall be for Petroleum;

(iv) $26,000,000 shall be for Natural Gas;

(v) $7,000,000 shall be for Cooperative Research and Development; and

(vi) $82,000,000 shall be for Supporting Activities, including Program Direction and Management Support, Environmental Restoration, [redacted], and Plant and Capital Equipment.

SEC. 5. MAJOR CONSTRUCTION POLICY.

(a) STATEMENT OF POLICY.--(1) It shall be the policy of the United States, with respect to substantial construction projects of the Department of Energy in civilian energy research and development areas, to authorize appropriations for the life of such substantial construction projects when the projects are initially authorized.

(2) It shall be the policy of the United States, with

respect to major construction projects of the Department of Energy in civilian energy research and development areas, to authorize appropriations for the life of such major construction projects when the preliminary design phase is completed and appropriate information is provided to the Congress with respect to anticipated costs and schedules.

(b) REPORT TO CONGRESS.--The Secretary shall, after completion of the preliminary design phase of a major construction project, submit to the Congress a report containing--

(1) an estimate of the total cost of construction of the facility;

(2) an estimate of the time required to complete construction;

(3) an estimate of the annual operating costs of the facility;

(4) the intended useful operating life of the facility; and

(5) an identification of any existing facilities to be closed as a result of the operation of the facility.

SEC. 6. ADVANCED NEUTRON SOURCE AND BURNING PLASMA EXPERIMENT MAJOR CONSTRUCTION REPORTS.

The Secretary shall, within 120 days after the date of completion of the preliminary design phase of the Advanced Neutron Source major construction project, and of the Burning

Plasma Experiment major construction project, provide the Congress with information on the anticipated cost and schedule with respect to each such project, to enable the Congress to consider authorization of each such project in its entirety as a major construction project.

SEC. 7. ATOMIC VAPOR LASER ISOTOPE SEPARATION.

(a) DEPLOYMENT CONTRACTOR.--The Secretary shall proceed expeditiously to procure a deployment contractor for the commercialization of the Atomic Vapor Laser Isotope Separation technology.

(b) IDENTIFICATION OF ALTERNATIVE APPLICATIONS.--The Secretary shall authorize the University of California and Martin Marietta Energy Systems, Inc. to enter into cooperative research and development agreements with private sector entities to identify and develop non-uranium enrichment applications of the Atomic Vapor Laser Isotope Separation technologies.

SEC. 8. STANDARDIZED COMMERCIAL NUCLEAR POWER PLANT.

(a) AWARD OF CONTRACT.--The Secretary shall award a contract for further design and engineering with respect to a standardized commercial nuclear power plant design that has been certified by the Nuclear Regulatory Commission.

(b) SELECTION CRITERIA.--The Secretary shall award the contract under subsection (a) to an entity that certifies to the satisfaction of the Secretary that--

(1) the plant will be constructed in the United States;

(2) at least 75 percent of all design, engineering, manufacture, and construction activities in connection with the plant shall be performed in the United States;

(3) the entity is a bona fide entity normally engaged in the design, engineering, manufacture, and construction of nuclear reactors;

(4) the entity has entered into a binding agreement for construction of a nuclear power plant with a utility or private entity whose primary purpose is the production of electrical power for public consumption; and

(5) the entity has the financial resources necessary, and fully intends, to pursue the design, engineering, manufacture, and construction of a full-scale nuclear power plant of at least 600 MWe in size through completion of construction and into operation.

(c) FUNDING.--The project described in this section shall receive at least 50 percent of its funding from non-Federal sources. Federal funding for such project shall not exceed $20,000,000 for each fiscal year, and the total of Federal funding over the course of such project shall not exceed $60,000,000.

SEC. 9. HISTORICALLY BLACK COLLEGES AND UNIVERSITIES.

The Secretary shall, within 6 months after the date of enactment of this Act, submit to the Congress a report outlining plans for increasing the participation of historically black colleges and universities in the Basic Energy Science programs of the Department of Energy.

SEC. 10. RESEARCH REACTOR USER COMPLEX.

(a) PURPOSE.--The purpose of this section is to establish the Fast Flux Test Facility as a multi-mission center for the purpose of conducting research and development on isotopes and energy, to be operated by the Department of Energy in partnership with international and domestic user organizations.

(b) ESTABLISMENT.--Not later than 90 days after the date of enactment of this Act, the Secretary shall establish a research, development, and production center at the Hanford Reservation in Richland, Washington, to be known as the ``Research Reactor User Complex'' (hereafter in this section referred to as the ``RRC'').

(c) AGREEMENTS; AUTHORIZED USES.--In establishing the RRC, the Secretary shall provide that the Department of Energy, and any contractors under contract with the Department of Energy to operate the RRC, may enter into agreements with non-Federal entities (including foreign governments and foreign entities) or a consortium of such entities to use the RRC for any of the following purposes:

(1) The production of industrial and medical isotopes

for use or sale, or both, by the non-Federal entities who have entered into the agreement.

(2) Irradiation services to support research or commercial objectives, or both.

(3) The production of steam to be used or sold, or both, by the non-Federal entities who have entered into the agreement.

(d) CHARGES.--The Secretary may assess such charges from non-Federal entities under an agreement entered into pursuant to subsection (c) as the Secretary determines may be necessary or appropriate to implement the purpose of this section.

(e) PERIOD OF AGREEMENT.--The Secretary shall not enter into an agreement pursuant to subsection (c) for a period of time exceeding 25 years.

(f) TERMINATION PROVISIONS.--(1) Under an agreement entered into pursuant to subsection (c), the Secretary may include a termination provision that requires the Department of Energy to pay for the unamortized balance of any special facilities acquired or constructed by the non-Federal entities who have entered into the agreement if--

(A) the RRC is shut down for lack of Federal appropriations; and

(B) the acquisition or construction of the special facilities constitutes a significant portion of the investment by the non-Federal entities under the agreement.

(2) A termination provision described in paragraph (1) may autnorize the use, for the purpose of paying such unamortized balance and any other costs resulting from termination, of any Federal funds available for operating expenses pursuant to subsection (j)(2).

(3) For purposes of this subsection, the term ``special facilities'' means any depreciable buildings, structures, utilities, machinery, equipment, materials, or services not made available to non-Federal entities by the Department of Energy.

(g) OTHER AGREEMENT PROVISIONS.--Under an agreement entered into pursuant to subsection (c), the Secretary may--

(1) make available to non-Federal entities facilities, equipment, utility services, fire protection, and other similar services;

(2) lease real or personal property to non-Federal entities to carry out the purpose of this section;

(3) include an appropriate indemnification pursuant to section 170 d. of the Atomic Energy Act of 1954 (42 U.S.C. 2210); and

(4) include such other terms and conditions as the Secretary determines will implement the purpose of this section.

(h) COMPETITIVE PROCEDURES.--In entering into a contract with a non-Federal entity pursuant to subsection (c), the Secretary may use procedures other than competitive procedures as described in section 303 of the Federal Property and Administrative Services Act of 1949 (41 U.S.C. 253).

(i) PROVISIONS RELATING TO DEPARTMENT OF ENERGY CONTRACTOR.--A contractor under contract with the Department of Energy to operate the RRC shall--

(1) maintain and operate the Fast Flux Text Facility under contract with and for the account of the Department of Energy pursuant to section 110 of the Atomic Energy Act of 1954 (42 U.S.C. 2140);

(2) ensure that all experiments meet applicable safety requirements and acceptable criteria; and

(3) provide necessary support services to the non-Federal entities that have entered into agreements pursuant to subsection (c).

(j) RRC FUND.--(1) There is established in the Treasury of the United States a separate fund to be known as the ``RRC Fund''. The RRC Fund shall consist of all amounts received by the Secretary from charges assessed under subsection (d).

(2) Subject to appropriations, the Secretary may make expenditures from the RRC Fund each fiscal year to offset the cost of operating the RRC in such fiscal year. Amounts in the

RRC Fund not needed for operations shall be invested in United States securities, the proceeds of which shall accrue to the RRC Fund.

SEC. 11. ANNUAL BUDGET SUBMISSION.

The Secretary shall annually submit to Congress, along with the President's budget request, a 3-year budget estimate for the civilian research and development programs of the Department of Energy, including funding estimates for each major account and new initiative.

SEC. 12. AUTHORIZATION RESTRICTION.

Notwithstanding any other provision of this Act--

(1) no amount appropriated pursuant to this Act may be used for any program for which funding was requested in an annual budget request of the President but for which the Congress declined to authorize funding; and

(2) no amount appropriated pursuant to this Act may be used for any program in excess of the amount authorized for that program under this Act.

Mrs. Lloyd. Is there any discussion of the amendment?

[No response.]

Mrs. Lloyd. Hearing none, the question is on my amendment. All those in favor, signify by saying aye.

[Chorus of ayes.]

Mrs. Lloyd. Opposed, no.

[No response.]

Mrs. Lloyd. The ayes have it, and the amendment is agreed to.

Are there further amendments?

[No response.]

Mrs. Lloyd. Hearing none, the question is on the approval of the bill, as amended.

All those in favor, signify by saying aye.

[Chorus of ayes.]

Mrs. Lloyd. Opposed, no.

[No response.]

Mrs. Lloyd. The ayes have it, the motion is agreed to and the bill is approved.

Mr. Smith. Madam Chairman, I have some report language I would like to offer.

Mrs. Lloyd. Mr. Smith is recognized at this time.

Mr. Smith. Madam Chairman, on page 45 of the draft report, after the last sentence in the paragraph entitled "Petroleum", I would like to insert the following language: "The subcommittee also realizes the importance of the independent producer in achieving domestic energy security, and urges the Secretary to work closely with the independent producer community in developing future advanced oil recovery techniques."

Madam Chairman, this language is probably self-explanatory. But once again, I would like to point out the reason for it. The fact that we should not forget is that independents in this Country, as we sit here, find more than half of the new oil and gas reserves. In addition, it is the independent producers that now count for over 40 percent of the oil and gas produced in the lower 48 States.

These independent producers do not have the large R&D budgets that the large major oil firms do. So there is obviously a need to recognize the independent producer, and I hope this language will be acceptable here.

[The report language offered by Mr. Smith follows:]

Report Language Offered by Rep. Lamar Smith

Insert in Report under paragraph entitled "Petroleum"

The Subcommittee also realizes the importance of the Independent Producer in achieving domestic energy security, and urges the Secretary to work closely with the independent producer community in developing future advanced oil recovery technologies.

Mrs. LLOYD. Thank you very much, Mr. Smith.

Members have a package of report language before them. Does any member wish to discuss his report language?

[No response.]

Mrs. LLOYD. I ask unanimous consent that all report language for the members be approved.

[No response.]

Mrs. LLOYD. Hearing no objection, so ordered.

[Report language offered by Mrs. Lloyd, Mr. Morrison, Mr. Wolpe, and by Mrs. Lloyd for Mr. Traficant follows:]

REPORT LANGUAGE
OFFERED BY MRS. LLOYD

On page 25, top paragraph, insert before the last sentence that begins with "Finally, as was discussed in the..."

"In that same trend, the Subcommittee continues to support DOE's on-going Advanced Controls research, and in particular, support ACTO at the level of $2.5 million for FY 1992 and FY 1993 as described in DOE's budget request."

REPORT LANGUAGE
OFFERED BY MRS. LLOYD

On page 33, third paragraph from the bottom, strike the last sentence and insert the following new sentence:

"The Subcommittee requests that the DOE conduct an independent assessment of the contribution that the Advanced Torroidal Facility (ATF) can make to this understanding and that DOE maintain ATF on standby until the results of the assessment can be considered in the context of the magnetic confinement development strategy."

REPORT LANGUAGE
OFFERED BY MRS. LLOYD

Proposed Change to First-of-a-Kind Language

(To be inserted on page 24 of the report after the 5th paragraph and before the paragraph which begins with the words, "The Request for Proposals", etc.)

It is to be understood; this offer is for first of a kind design for the express purpose of building a new nuclear powerplant. Should for any reason, due to the fault of the Offeror or his successor(s), the project be terminated or stopped for a period exceeding 18 months before the completion of construction, the Offeror or his successor(s) shall be liable to repay the government for the total amount of the government funds invested up that time.

Report language offered by Mr. Morrison

To be added after Table 20 in the section discussing Environmental Restoration and Waste Management:

The Subcommittee supports the Environmental and Molecular Sciences Laboratory (EMSL), believing the thrust and scope of the EMSL will be extremely valuable in addressing several scientific challenges facing the Nation. The Subcommittee also supports the Secretary of Energy's efforts to accelerate the construction of EMSL and make equipment and instruments within EMSL available for collaborative research programs in the international scientific community.

Report language offered by Mr. Morrison

To be added after the paragraph headed Space Reactor Power Systems on page 25 in the section headed Subcommittee Recommendations for Nuclear Energy R&D.

Advanced Radioisotope Power Systems

The Subcommittee recommends that DOE reevaluate deferring activities related to the RPSF. To defer activities at this time will leave DOE with another unfinished project. Restart after deferral will significantly increase the overall project cost and schedule. To maintain RPSF in a safe and environmentally sound condition such that it can best be utilized for future NASA and DOD missions requires DOE to complete the project. Completing RPSF will provide DOE with a completed RTG assembly facility that meets all current criteria.

Proposed Rept. Language - Mr. Wolpe

Transfer of Manufacturing Technology from Department of Energy Laboratories

Within the Basic Energy Sciences program, a sum of $1.6 million is authorized to fund a continuing research and development program at the Industrial Technology Institute. The Institute will utilize a Manufacturing Needs Tool previously demonstrated to inform laboratory personnel of manufacturing needs and identify laboratory-based technologies for technology transfer through further development and commercialization. The Subcommittee supports the work of the Institute and directs the Department to continue funding the activity.

Report language offered by Mrs. Lloyd for Mr. Traficant

Petroleum Research and Development

On page 45 of the report, on line 9 of the Petroleum language replace the sentence that begins "The Subcommittee also believes in the need to continue a modest effort to maintain a core oil shale research and development program and does not endorse the DOE's request for close-out of the activity," and replace it with "The Subcommittee also believes in the need to continue a modest effort to maintain a core oil shale research and development program, including the scale-up of eastern oil shale technology, and does not endorse the DOE's request for close-out of the activity.

Mrs. LLOYD. Mr. Wolpe.

Mr. WOLPE. I think I really like that, Madam Chairman.

Just as a way of clarifying the process at this point. I understand that it will probably be necessary for the work of this subcommittee to be reconciled in some fashion with the work of other subcommittees in advance of the full Committee markup.

Mrs. LLOYD. That is correct, we expect the Environment Committee to work out their's. So it's my understanding that we will bring both bills before the full Committee at one hearing so that they can be combined before it s reported out.

Mr. WOLPE. But there may also be a need to make some adjustments and the various numbers of the subcommittees.

Mrs. LLOYD. That's right. I stated a little earlier that the reconciliation can be made where there are differences and try to work out a coherent policy with the two.

Mr. WOLPE. Thank you.

Mrs. LLOYD. Mr. Wolpe, I appreciate your work on this Committee. Even though we have differences in viewpoint from time to time, we seem to do it in a very friendly fashion. I appreciate that.

Mr. Stallings.

Mr. STALLINGS. Madam Chairman, I have a couple of amendments for the report.

Mrs. LLOYD. The gentleman is recognized.

Mr. STALLINGS. They both are to be inserted on page 25 of the report. The first one deals with the advanced reactors research and development. On page 25, line 2, I would like to have the following sentence inserted. "Of the total funds provided for the advanced reactors research and development programs, no less than $25 million is authorized for the integral fast reactor development work and no less than $4 million is authorized for the actinide recycle program."

Madam Chairman, as you are aware, the Department of Energy's budget request for the advanced reactors research and development included only $49.5 million. I am pleased that the subcommittee's recommendation provides $60.5 million.

[The amendments offered by Mr. Stallings follow:]

Amendment Offered by Mr. Stallings
to the Committee Report

Advanced Reactors Research and Development

On page 25, line 2, After "MHTGR Development." insert the following new sentence.

Of the total funds provided for the Advanced Reactors Research and Development programs, no less than $25 million is authorized for the Integral Fast Reactor development work and no less than $4 million is authorized for the actinide recycle program.

Amendment Offered by Mr. Stallings
to the Committee Report

Space Exploration Initiative (SEI)

On page 25, after the first two sentences, strike the the rest of the paragraph and insert in lieu thereof the following report language.

The Subcommittee is concerned that Department of Energy and NASA witnesses did not provide sufficient information to properly evaluate the Fiscal Year 1992 budget request and the merits of the SEI program. In light of this concern, the Subcommittee directs DOE to prepare a detailed plan, in consultation with the user agencies, outlining its scope, objectives, requirements, estimated cost, and schedule for this program. The report shall be submitted to the Subcommittee by December 31, 1991.

Mrs. **Lloyd**. Would the gentleman yield?

We have already approved a motion to include all that in.

Mr. **Stallings**. All right. I apologize. I missed that in the speed with which you are——

Mrs. **Lloyd**. We are moving with much deliberance.

Mr. **Stallings**. You are doing a great job and I certainly support you. [Laughter.]

Let me just make the other comment that I would like to at this point.

I am somewhat concerned on the space exploration initiative. I would like to be involved in the negotiations that take place afterwards. I know the Department requested some $30 million and this subcommittee is authorizing only $5 million for this space exploration initiative. I think that there will be some ongoing recommendations, as I understand Mr. Brown and Mr. Walker are in the process of negotiating at this point. I don't want to do anything that will upset that, but I would like to be included in any further discussions of this.

Mrs. **Lloyd**. Well, certainly, the gentleman will be included in any discussions.

I said earlier, and Mr. Morrison also expressed his concern, that we hope that before we get to full Committee this reconciliation can be made.

Mr. **Stallings**. Thank you.

Mrs. **Lloyd**. I want to thank the gentleman for his outstanding work on this Committee. I don't think there's any Committee that is better served by diligent hard-working members than we are on this Committee. I am very grateful as the Chairman of the Committee.

Are there any further amendments to the bill?

[No response.]

Mrs. **Lloyd**. Hearing none, the question is on the approval of the bill as amended.

All those in favor, signify by saying aye.

[Chorus of ayes.]

Mrs. **Lloyd**. Opposed, no.

[Chorus of noes.]

Mrs. **Lloyd**. The ayes have it, the motion is agreed to, and the bill is approved.

Mr. Fawell.

Mr. **Fawell**. Madam Chairman, I move that the subcommittee report the bill, the Energy Technology Research and Development Authorization Act of 1992 and 1993 as amended. Furthermore, I move to instruct the staff to prepare the subcommittee report, to make technical and conforming amendments, and that the Madam Chairman make all the necessary steps to bring the bill before the full Committee for consideration.

Mrs. **Lloyd**. The question now occurs on reporting the bill.

All those in favor, signify by saying aye.

[Chorus of ayes.]

Mrs. **Lloyd**. Opposed, no.

[Chorus of noes.]

Mrs. **Lloyd**. The ayes have it, the bill is reported. The business of the subcommittee having been completed, the subcommittee—the gentleman from Illinois.

Mr. **Fawell**. Madam Chairman, I further move that a clean bill be prepared by Madam Chairman for introduction in the House for further consideration by the Committee.

Mrs. **Lloyd**. All those in favor, signify by saying aye.

[Chorus of ayes.]

Mrs. **Lloyd**. Opposed, no.

[No response.]

Mrs. **Lloyd**. The ayes have it, and it is now approved.

The business of the subcommittee having been completed, the subcommittee stands adjourned.

[Whereupon, at 10:46 a.m., the subcommittee adjourned, to reconvene at the call of the Chair.]

DISSENTING VIEWS OF REP. HOWARD WOLPE

I strongly oppose passage of the "Energy Technology Research and Development Authorization Act of 1991" for three fundamental reasons. First, I object to the energy R&D priorities contained in this bill. Second, I am disturbed by the lack of any meaningful priority setting process that employs objective criteria to apportion scarce federal resources. And third, I am concerned that the huge increases contained in this bill will threaten investments in DOE energy R&D programs that fall within the jurisdiction of the Environment Subcommittee.

Fundamental Concerns

The Persian Gulf War has once again demonstrated our nation's dangerous over-dependence on petroleum. Simultaneously, the federal government faces severe fiscal constraints that limit our ability to make investments to reduce that dependence. These circumstances demand fiscal discipline.

With such limited resources at our disposal we simply cannot tolerate spending that lacks justification. I submit that we should be making some effort to more systematically match energy R&D spending to national energy policy goals. This seems like simple common sense, but from my experience energy R&D priorities are more typically established not by employing objective criteria or measurements of evaluation, but in response to parochial interests or special interest pressure.

The administration's National Energy Strategy contains numerous examples of this mismatch between stated goals and energy R&D priorities. For example, the National Energy Strategy acknowledges the necessity of addressing our oil vulnerability through R&D investments:

> "One of the keys to ensuring future energy security is reducing U.S. oil vulnerability. Technological advancements are one of the best ways to achieve this, and the National Energy Strategy

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> calls for increasing investments for technology research and development (R&D) in areas with the greatest potential for reducing oil vulnerability."[1]

I could not agree more. We must increase investments in R&D in areas with the greatest potential for reducing oil vulnerability. Unfortunately, the R&D priorities contained in both the National Energy Strategy and this legislation don't match this goal.

Both the NES and this legislation propose massive increases in nuclear fission R&D programs for FY 1992. These proposed increases fail to address effectively the goal of reducing our oil vulnerability. Nuclear energy produces electricity, while less than five percent of U.S. petroleum consumption is used in the generation of electricity.

The administration tries to justify this by claiming that the U.S. faces electricity shortages at the end of the decade. For the sake of argument, I will accept that claim at face value. But where does the administration propose to focus our advanced electricity R&D dollars? They propose that 90 percent of the increased electricity R&D dollars be spent on nuclear power programs. By contrast, they propose that photovoltaic cells that convert sunlight to electricity receive only six percent of the increase. This distribution of R&D dollars was apparently arbitrary. There is no evidence that DOE engaged in any kind of analysis that compared the potential of competing technologies to meet the anticipated demand for electricity.

The administration's own base case projections indicate that if it were left to the market place nuclear power would cease to produce any power in America in the year 2030. On the other hand, the cost of electricity from photovoltaic cells has dropped from over $3 a kilowatt-hour in 1980 to 30 cents today with relatively little federal R&D support.

The administration's energy R&D priorities can be summarized this way: Reducing petroleum consumption is the stated goal, but over 50 percent of the increased R&D spending is focused on a technology that can't effectively displace petroleum. And to make matters worse, they have chosen to gamble millions of scarce R&D dollars on a long-shot attempt to resuscitate a dying technology, while refusing to give a significant boost to an emerging technology whose entrance into the market place could be accelerated with additional federal support.

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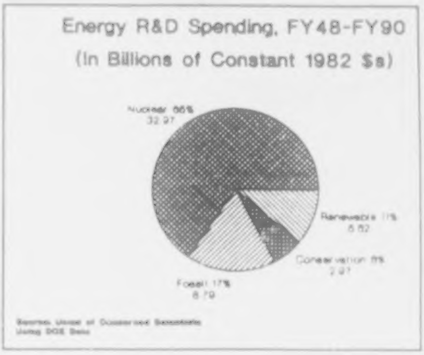
[1] U.S. Department of Energy, National Energy Strategy: Powerful Ideas for America, First Edition 1991/1992, p. 136, U.S. DOE, Washington, D.C. 20585


Energy R&D Spending, FY48-FY90
(In Billions of Constant 1982 $s)

When I asked the Assistant Secretary of Energy for Nuclear Programs why the administration was targeting such large sums to nuclear R&D, he replied that such support was necessary so that nuclear energy could compete on a "level playing field" with other technologies. In light of the fact that nuclear energy has received over 65 percent of federal energy R&D spending in the last 40 years, that was a truly astounding observation. (See box.)

When pressed further to justify the National Energy Strategy's heavy emphasis on nuclear energy, the following exchange occurred:

> ASSISTANT SECRETARY YOUNG: The fundamental basis for the various projections in the NES is that all technologies must compete on an economic basis. When you remove the obstacles to nuclear power, nuclear power can do that...
>
> REP. WOLPE: Can you provide documentation to prove that?
>
> ASSISTANT SECRETARY YOUNG: Certainly we can.
>
> REP. WOLPE: Would you get that--
>
> ASSISTANT SECRETARY YOUNG: We have detailed analyses backing up the NES that we could provide.

Despite repeated requests, I have yet to receive any data from DOE justifying their decision to make the resuscitation of the nuclear industry one of the cornerstones of the National Energy Strategy.

In spite of receiving two-thirds of energy R&D dollars over the last 40 years, nuclear energy provided less than seven percent of the nation's energy in 1989. **In a time of tight budgets and energy insecurity, we simply cannot afford to continue to receive so little bang for the federal R&D buck.** Unfortunately, the energy R&D priorities contained in both this legislation and the NES continue the business-as-usual tradition of providing subsidies to the nuclear industry on the basis of parochial concerns and special interest pressures.

Additional Concerns

In addition to the fundamental concerns outlined above, I am troubled by a number of other items contained in this legislation.

AVLIS

I strongly object to the $15 million that the Subcommittee has added to the administration's request for pre-deployment activities for AVLIS technology. DOE has requested $213.6 million for AVLIS in FY 1992. A January 1990 DOE report entitled "Plan for the Demonstration, Transition and Deployment of U-AVLIS Technology" indicates that a demonstration of the U-AVLIS technology will be completed in September 1992.

I can support the administration's request with the following condition: at the end of FY 1992, federal expenditures must be limited to the relatively small amounts necessary to transfer the technology to any and all interested parties in the private sector. The federal government's past mismanagement of uranium enrichment activities has already cost the American taxpayers billions of dollars.

To prevent another costly fiasco, the federal government's involvement with AVLIS technology should conclude at the end of the demonstration phase. It will then be up to the market place to determine if AVLIS technology is commercially viable. The pre-deployment activities required in this legislation clearly cross the line between making a technology available to the market place, and attempting to force a technology on the market place.

Space Programs

A portion of the administration's request for nuclear energy R&D is targeted to space-related activities. The administration apparently believes that the space program would benefit by launching new initiatives outside of NASA. This is a losing proposition any way that you look at it.

First, mixing space and energy programs together will only make it more difficult to establish priorities at DOE to meet national energy goals. Second, DOE has had enough trouble trying to direct civilian energy programs while operating the nuclear weapons complex. The nation's energy problems are of sufficient importance that any efforts to further distract DOE should be discouraged. Third, based on DOE's track record of managing federal uranium enrichment activities, the national laboratories, and the weapons complex, supporters of the space program should be very careful about entrusting an important new program to their care. It would be advisable to address directly problems at NASA, rather than moving programs to what may be an even more troubled agency.

Federal Facilities

I am concerned about the Subcommittee's effort to establish a new research and development facility at the Fast Flux Test Facility without the support of the DOE. The DOE has determined that the work accomplished at the FFTF facility could be more efficiently accomplished elsewhere. Federal dollars spent in FY 1992 keeping this facility open pending a final determination of its fate must be kept at a minimum.

APPENDIX II

FULL COMMITTEE MARKUP OF H.R. 2399, ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT AUTHORIZATION ACT OF 1991

WEDNESDAY, MAY 22, 1991

House of Representatives,
Committee on Science, Space, and Technology,
Washington, DC.

The committee met, pursuant to notice, at 10:27 a.m., in room 2318, Rayburn House Office Building, Hon. George E. Brown, Jr. (chairman of the committee) presiding.

The **Chairman**. The committee will come to order.

Obviously, a lot of important business is still being transacted up here, but we need to move ahead.

This morning, the committee will take up three authorization bills: H.R. 2282, the National Science Foundation Authorization Act Amendments of 1991; H.R. 2399, the Energy Technology Research and Development Authorization Act of 1991; and H.R. 2404, the Environmental Research, Development, and Demonstration Authorization Act of 1991.

After today's markup, the committee will have completed its markups of all the major authorization bills. It's the first time in many years that the committee has ordered reported all of its authorization bills before the Memorial Day recess. I think this is a noteworthy event, and I want to commend all of the subcommittee chairs and the ranking Republican members for their hard work in moving these bills through to the full committee in such a timely and cooperative fashion.

With these bills, we have also exercised budget discipline and met the commitment to set priorities and make hard decisions. Taken together, the funding in all of the committee's authorization bills does not exceed the total funding requested in the President's budget for the agencies under this committee's jurisdiction, and that also sets a record of sorts.

Setting priorities within the President's budget request has not been an easy task. Many of us can identify worthwhile programs which simply will not be funded at levels we believe are appropriate. There simply isn't enough money in the budget to do all that we can to bolster our economic competitiveness in the global high-technology market; to fund cutting-edge scientific research in a wide field of scientific disciplines; to explore space, the final frontier, to find new ways to use energy cleanly and wisely; and to protect and clean up our environment. As in any political process, we have made compromises, and while not everyone is happy about everything in all of our bills, I'm confident that most of the members share my view that we have arrived at an appropriate consensus on our science funding priorities as far as we can determine at this time.

I want to commend all of the members of the committee on both sides for their efforts in this first-time effort to set some meaningful priorities for the programs under our jurisdiction.

I might add just briefly to that that there remain, of course, a few items which have not been fully resolved or worked out and, in fact, are in the process of being negotiated. We will try and defer including these in today's legislation until we have reached some sort of a consensus on it, and I intend, in that event, to bring these relatively small number of additional items to the floor as Chairman's amendments after we have had further negotiations on them. I make this as a good faith promise, and I hope that this will make some people, at least, a little less unhappy at the thought that they didn't get everything that they may have wanted in the legislation before us.

Now, let me at this point recognize our ranking minority member, Mr. Walker, for any general remarks before we move to the first bill, which is the National Science Foundation Act.

Bob.

Mr. WALKER. Mr. Chairman, I don't have any real opening remarks. I prefer to move on to the NSF bill, where I will have some remarks.

The CHAIRMAN. All right. Let's proceed, then, to the NSF bill, H.R. 2282.

The next order of business is H.R. 2399, the committee markup on the Energy Technology Research and Development Authorization Act of 1991.

[A copy of H.R. 2399 follows:]

102d CONGRESS
1st SESSION

H.R. ______

______
(Original signature of Member)

Insert title here ☞

To authorize appropriations for research and development and demonstration activities of the Department of Energy for fiscal years 1992 and 1993, and for other purposes.

IN THE HOUSE OF REPRESENTATIVES

______, 19__

Insert sponsor's names here ☞

Mrs. LLOYD (for herself and Mr. Morrison) introduced the following bill; which was referred to the Committee on ______

A BILL

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the ``Energy Technology Research and Development Authorization Act of 1991''.

SEC. 2. FINDINGS.

The Congress finds that--

(1) the development of new energy technologies is a necessary step in reducing oil imports and providing for our Nation's energy needs in the 21st century;

(2) the development of efficient, economic, safe, and environmentally acceptable energy technologies is a necessary part of an effective National Energy Strategy;

(3) technological advances in the recovery and use of our fossil fuel resources will provide time for an orderly transition to other energy sources while at the same time reducing our vulnerability to supply disruptions, price escalations, and the environmental side effects of fossil fuel use; and

(4) technology development occurs over a time span that is often measured in years or even decades, therefore, commitments to new energy technology development must be consistent with those time requirements and cannot be made on a year-to-year basis.

SEC. 3. DEFINITIONS.

For purposes of this Act--

(1) the term ``major construction project'' means a project whose construction costs are estimated to exceed $100,000,000 over the life of the project;

(2) the term ``Secretary'' means the Secretary of Energy; and

(3) the term ``substantial construction project'' means a project whose construction costs are estimated to exceed $10,000,000, but not to exceed $100,000,000, over the life of the project;

SEC. 4. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated to the Secretary the following amounts:

(1) Supporting Research and Technical Analysis--

(A) Basic Energy Sciences Program--

(i) $714,700,000 for fiscal year 1992, of which $6,300,000 shall be for completion of construction of the Advanced Light Source and $90,400,000 shall be for construction of the Advanced Photon Source;

(ii) $836,500,000 for operating, capital equipment, and construction for fiscal year 1993, of which $437,600,000 shall be for research activities, $196,000,000 shall be for the operation of user facilities, $112,500,000 shall be for construction of the Advanced Photon

Source, and $38,900,000 shall be for construction of the Advanced Neutron Source;

(iii) $93,000,000 for fiscal year 1994 shall be for construction of the Advanced Photon Source; and

(iv) $45,000,000 for fiscal year 1995 shall be for completion of the construction of the Advanced Photon Source;

(B) Energy Research Analysis Program, $4,000,000 for fiscal year 1992, and $4,200,000 for fiscal year 1993;

(C) Multiprogram Energy Laboratories Facilities Support program, $23,900,000 for fiscal year 1992, and $24,900,000 for fiscal year 1993;

(D) University and Science Education, $57,500,000 for fiscal year 1992, and $72,900,000 for fiscal year 1993; and

(E) Advisory and Oversight Program Direction and Policy Management for Energy Research activities, $10,100,000 for fiscal year 1992, and $10,500,000 for fiscal year 1993.

(2) Nuclear Energy--

(A) Nuclear Energy Research and Development Program, $391,000,000 for fiscal year 1992, and $420,000,000 for fiscal year 1993, including--

(i) Certification of Light Water Reactor Designs, $44,500,000, for fiscal year 1992, of which $2,000,000 shall be for first-of-a-kind engineering for initiating the first standardized commercial nuclear power plant, and $62,500,000 for fiscal year 1993, of which $20,000,000 shall be for first-of-a-kind engineering for initiating the first standardized commercial nuclear power plant;

(ii) Advanced Reactor Research and Development, $60,500,000 for fiscal year 1992, and $73,000,000 for fiscal year 1993;

(iii) Space Reactor Power Systems, $36,000,000 for fiscal year 1992, and $36,500,000 for fiscal year 1993;

(iv) Advanced Radioisotope Power, $56,000,000 for fiscal year 1992, and $58,000,000 for fiscal year 1993;

(v) Space Exploration Initiative, $5,000,000 for fiscal year 1992, and $5,000,000 for fiscal year 1993;

(vi) Facilities Support, including operations, capital equipment, and general plant construction, $178,800,000 for fiscal year 1992, of which $79,000,000 shall be for the Fast Flux

Test Facility, and $168,800,000 for fiscal year 1993, of which $69,000,000 shall be for the Fast Flux Test Facility; and

(vii) Program Direction, Nuclear Energy, $10,200,000 for fiscal year 1992, and $16,200,000 for fiscal year 1993; and

(B) For developing and conducting an integrated research and development program to explore new technologies for reducing, treating, transmuting, separating, recycling, storing, or otherwise mitigating hazards associated with high level radioactive waste and spent fuel from nuclear reactors, $8,000,000 for fiscal year 1992, and $8,320,000 for fiscal year 1993.

(3) Fusion Energy Research and Development--

(A) Magnetic Fusion Energy Research, including operating activities, program direction, capital equipment, and construction activity--

(i) $328,900,000 for fiscal year 1992, of which--

(I) $30,000,000 shall be for preconstruction activities of the Burning Plasma Experiment facility; and

(II) $41,800,000 shall be for the Engineering Design Activity of the

International Thermonuclear Engineering Reactor; and

(ii) $387,000,000 for fiscal year 1993, of which $35,400,000 shall be for construction of the Burning Plasma Experiment facility; and

(B) Inertial Confinement Fusion Program, $8,200,000 for fiscal year 1992, and $14,000,000 for fiscal year 1993.

(4) Atomic Vapor Laser Isotope Separation Program--

(A) $228,600,000 for fiscal year 1992, of which--

(i) $219,300,000 shall be for operations, including $20,000,000 for procurement of a commercial deployment contractor and a predeployment assessment of the demonstration of Atomic Vapor Laser Isotope Separation technology and the preparation of a report to the Congress, to be submitted within 90 days after completion of such demonstration, on the economic market, financing, and risk assessment for commercial deployment of such technology;

(ii) $6,100,000 shall be for capital equipment; and

(iii) $3,200,000 shall be for construction; and

(B) $225,800,000 for fiscal year 1993.

(5) Environmental Restoration and Waste Management Program, for corrective activities, environmental restoration, waste management, and related technology development for civilian programs and activities of the Department of Energy, $523,500,000 for fiscal year 1992, and $594,200,000 for fiscal year 1993.

(6) Fossil energy--

(A) $471,000,000 for fiscal year 1992, of which--

(i) $206,000,000 shall be for Basic and Supporting Research, including Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification, and Surface Coal Gasification;

(ii) $89,000,000 shall be for Advanced Technology Development, including $48,000,000 for Fuel Cells, and $41,000,000 for Magnetohydrodynamics;

(iii) $70,000,000 shall be for Petroleum;

(iv) $23,000,000 shall be for Natural Gas;

(v) $6,000,000 shall be for Cooperative Research and Development; and

(vi) $77,000,000 shall be for Supporting Activities, including Program Direction and Management Support, Environmental Restoration, and Plant and Capital Equipment; and

(B) $507,000,000 for fiscal year 1993, of which--

(i) $214,000,000 shall be for Basic and Supporting Research, including Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification, and Surface Coal Gasification;

(ii) $88,000,000 shall be for Advanced Technology Development, including $60,000,000 for Fuel Cells, and $28,000,000 for Magnetohydrodynamics;

(iii) $90,000,000 shall be for Petroleum;

(iv) $26,000,000 shall be for Natural Gas;

(v) $7,000,000 shall be for Cooperative Research and Development; and

(vi) $82,000,000 shall be for Supporting Activities, including Program Direction and Management Support, Environmental Restoration, and Plant and Capital Equipment.

SEC. 5. MAJOR CONSTRUCTION POLICY.

(a) STATEMENT OF POLICY.--(1) It shall be the policy of the United States, with respect to substantial construction projects of the Department of Energy in civilian energy research and development areas, to authorize appropriations for the life of such substantial construction projects when the projects are initially authorized.

(2) It shall be the policy of the United States, with respect to major construction projects of the Department of Energy in civilian energy research and development areas, to authorize appropriations for the life of such major construction projects when the preliminary design phase is completed and appropriate information is provided to the Congress with respect to anticipated costs and schedules.

(b) REPORT TO CONGRESS.--The Secretary shall, after completion of the preliminary design phase of a major construction project, submit to the Congress a report containing--

(1) an estimate of the total cost of construction of the facility;

(2) an estimate of the time required to complete construction;

(3) an estimate of the annual operating costs of the facility;

(4) the intended useful operating life of the facility; and

(5) an identification of any existing facilities to be closed as a result of the operation of the facility.

SEC. 6. ADVANCED NEUTRON SOURCE AND BURNING PLASMA EXPERIMENT MAJOR CONSTRUCTION REPORTS.

The Secretary shall, within 120 days after the date of completion of the preliminary design phase of the Advanced Neutron Source major construction project, and of the Burning Plasma Experiment major construction project, provide the Congress with information on the anticipated cost and schedule with respect to each such project, to enable the Congress to consider authorization of each such project in its entirety as a major construction project.

SEC. 7. ATOMIC VAPOR LASER ISOTOPE SEPARATION.

(a) DEPLOYMENT CONTRACTOR.--The Secretary shall proceed expeditiously to procure a deployment contractor for the commercialization of the Atomic Vapor Laser Isotope Separation technology.

(b) IDENTIFICATION OF ALTERNATIVE APPLICATIONS.--The Secretary shall authorize the University of California and Martin Marietta Energy Systems, Inc. to enter into cooperative research and development agreements with private sector entities to identify and develop non-uranium enrichment applications of the Atomic Vapor Laser Isotope Separation technologies.

SEC. 8. STANDARDIZED COMMERCIAL NUCLEAR POWER PLANT.

(a) AWARD OF CONTRACT.--The Secretary shall award a contract for further design and engineering with respect to a standardized commercial nuclear power plant design that has been certified by the Nuclear Regulatory Commission.

(b) SELECTION CRITERIA.--The Secretary shall award the contract under subsection (a) to an entity that certifies to the satisfaction of the Secretary that--

(1) the plant will be constructed in the United States;

(2) at least 75 percent of all design, engineering, manufacture, and construction activities in connection with the plant shall be performed in the United States;

(3) the entity is a bona fide entity normally engaged in the design, engineering, manufacture, and construction of nuclear reactors;

(4) the entity has entered into a binding agreement for construction of a nuclear power plant with a utility or private entity whose primary purpose is the production of electrical power for public consumption; and

(5) the entity has the financial resources necessary, and fully intends, to pursue the design, engineering, manufacture, and construction of a full-scale nuclear power plant of at least 600 MWe in size through completion of construction and into operation.

(c) FUNDING.--The project described in this section shall receive at least 50 percent of its funding from non-Federal sources. Federal funding for such project shall not exceed $20,000,000 for each fiscal year, and the total of Federal funding over the course of such project shall not exceed

$60,000,000.

SEC. 9. HISTORICALLY BLACK COLLEGES AND UNIVERSITIES.

The Secretary shall, within 6 months after the date of enactment of this Act, submit to the Congress a report outlining plans for increasing the participation of historically black colleges and universities in the Basic Energy Science programs of the Department of Energy.

SEC. 10. RESEARCH REACTOR USER COMPLEX.

(a) PURPOSE.--The purpose of this section is to establish the Fast Flux Test Facility as a multi-mission center for the purpose of conducting research and development on isotopes and energy, to be operated by the Department of Energy in partnership with international and domestic user organizations.

(b) ESTABLISMENT.--Not later than 90 days after the date of enactment of this Act, the Secretary shall establish a research, development, and production center at the Hanford Reservation in Richland, Washington, to be known as the ``Research Reactor User Complex'' (hereafter in this section referred to as the ``RRC'').

(c) AGREEMENTS; AUTHORIZED USES.--In establishing the RRC, the Secretary shall provide that the Department of Energy, and any contractors under contract with the Department of Energy to operate the RRC, may enter into agreements with non-Federal entities (including foreign governments and foreign entities) or a consortium of such entities to use the RRC for any of the following purposes:

(1) The production of industrial and medical isotopes for use or sale, or both, by the non-Federal entities who have entered into the agreement.

(2) Irradiation services to support research or commercial objectives, or both.

(3) The production of steam to be used or sold, or both, by the non-Federal entities who have entered into the agreement.

(d) CHARGES.--The Secretary may assess such charges from non-Federal entities under an agreement entered into pursuant to subsection (c) as the Secretary determines may be necessary or appropriate to implement the purpose of this section.

(e) PERIOD OF AGREEMENT.--The Secretary shall not enter into an agreement pursuant to subsection (c) for a period of time exceeding 25 years.

(f) TERMINATION PROVISIONS.--(1) Under an agreement entered into pursuant to subsection (c), the Secretary may include a termination provision that requires the Department of Energy to pay for the unamortized balance of any special facilities acquired or constructed by the non-Federal entities who have entered into the agreement if--

(A) the RRC is shut down for lack of Federal appropriations; and

(B) the acquisition or construction of the special facilities constitutes a significant portion of the investment by the non-Federal entities under the agreement.

(2) A termination provision described in paragraph (1) may authorize the use, for the purpose of paying such unamortized balance and any other costs resulting from termination, of any Federal funds available for operating expenses pursuant to subsection (j)(2).

(3) For purposes of this subsection, the term ``special facilities'' means any depreciable buildings, structures, utilities, machinery, equipment, materials, or services not made available to non-Federal entities by the Department of Energy.

(g) OTHER AGREEMENT PROVISIONS.--Under an agreement entered into pursuant to subsection (c), the Secretary may--

(1) make available to non-Federal entities facilities, equipment, utility services, fire protection, and other similar services;

(2) lease real or personal property to non-Federal entities to carry out the purpose of this section;

(3) include an appropriate indemnification pursuant to section 170 d. of the Atomic Energy Act of 1954 (42 U.S.C. 2210); and

(4) include such other terms and conditions as the Secretary determines will implement the purpose of this section.

(h) COMPETITIVE PROCEDURES.--In entering into a contract with a non-Federal entity pursuant to subsection (c), the Secretary may use procedures other than competitive procedures as described in section 303 of the Federal Property and Administrative Services Act of 1949 (41 U.S.C. 253).

(i) PROVISIONS RELATING TO DEPARTMENT OF ENERGY CONTRACTOR.--A contractor under contract with the Department of Energy to operate the RRC shall--

(1) maintain and operate the Fast Flux Text Facility under contract with and for the account of the Department of Energy pursuant to section 110 of the Atomic Energy Act of 1954 (42 U.S.C. 2140);

(2) ensure that all experiments meet applicable safety requirements and acceptable criteria; and

(3) provide necessary support services to the non-Federal entities that have entered into agreements pursuant to subsection (c).

(j) RRC FUND.--(1) There is established in the Treasury of the United States a separate fund to be known as the ``RRC Fund''. The RRC Fund shall consist of all amounts received by the Secretary from charges assessed under subsection (d).

(2) Subject to appropriations, the Secretary may make expenditures from the RRC Fund each fiscal year to offset the cost of operating the RRC in such fiscal year. Amounts in the RRC Fund not needed for operations shall be invested in United States securities, the proceeds of which shall accrue to the RRC Fund.

SEC. 11. COST SHARING GUIDELINES.

The Secretary shall conduct a study of the appropriateness of cost sharing requirements for fossil research and development projects of the Department of Energy, taking into account the type of project and costs required for completion. Within 6 months after the date of enactment of this Act, the Secretary shall submit to the Congress a report containing the results of such study, along with proposed guidelines for cost sharing with respect to such projects, including provisions regarding the use of data, rights of parties, and ownership of the research results or technologies developed.

SEC. 12. ANNUAL BUDGET SUBMISSION.

The Secretary shall annually submit to Congress, along with the President's budget request, a 3-year budget estimate for the civilian research and development programs of the Department of Energy, including funding estimates for each major account and new initiative.

SEC. 13. AUTHORIZATION RESTRICTION.

Notwithstanding any other provision of this Act--

(1) no amount appropriated pursuant to this Act may be used for any program for which funding was requested in an annual budget request of the President but for which the Congress declined to authorize funding; and

(2) no amount appropriated pursuant to this Act may be used for any program in excess of the amount authorized for that program under this Act.

The CHAIRMAN. Let me make a comment with regard to this. I think all of us are aware that it's been some time since this committee has passed an authorization bill for energy R&D. I want to recognize and praise the diligence of both Chairman Lloyd and Chairman Scheuer in moving to report responsible packages out of their respective subcommittees. We have made some minor adjustments in the subcommittee funding recommendations in order to accommodate our wish to bring the overall total authorization within the budget limit requested by the President.

I believe that we have in this markup vehicle a fiscally responsible approach to balancing a very complex set of program needs. The fiscal constraints within which we are operating make worthy programs compete for limited funding. This authorization bill recognizes those constraints.

We are proposing to strengthen the Energy Conservation and Renewable Energy Research Programs. The Administration's national energy strategy documents acknowledge the importance of strengthening conservation and renewable energy R&D. Unfortunately, the amount included in the President's request was not sufficient, and the budget request of the Administration did not reflect the importance of these two areas.

Improving our energy efficiency and developing new high-efficiency technology is absolutely fundamental to meeting America's future energy needs in an economical and environmentally sound manner. Greater energy efficiency, along with expediting the development and deployment of energy supply technologies based on renewable energy resources, is essential for maintaining our international economic competitiveness. Beyond that, energy efficiency and renewable energy are essential for moving us in the direction of an environmentally sustainable future.

I didn't realize I had such a long opening statement here. [Laughter.]

The CHAIRMAN. I ask unanimous consent that the remainder of my opening statement be included in the record at this point, and I will have an amendment which I will offer later, and I will explain it at that point.

May I just say in a general fashion that I'm not totally satisfied with this bill. It does not completely authorize all of the energy programs that I think this committee ought to be authorizing, but we're going to take it a step at a time. We're going to do the best we can this year, and we'll come back and do even better next year if we are able to do so, and I regard this bill before us as a very significant step in the proper direction for this committee.

Mr. Walker.

[The prepared opening statement of Mr. Brown follows:]

THE HONORABLE GEORGE E. BROWN, JR.

OPENING STATEMENT

MAY 22, 1991

FULL COMMITTEE MARK-UP OF THE ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT AUTHORIZATION ACT OF 1991

Today we have before us for Committee Mark-Up the Energy Technology Research and Development Authorization Act of 1991, the authorization for the Department of Energy's Civilian Research and Development Programs.

As you know, it has been some time since this Committee has passed an authorization bill for Energy R&D. I want to recognize and praise the diligence of Chairman Scheuer and Chairman Lloyd in moving to report responsible packages out of their respective Subcommittees.

We have made some minor adjustments in the Subcommittee funding recommendations, in order to accommodate our wish to bring the overall total authorization within the budget limit requested by the President.

I believe that we have in this mark-up vehicle a fiscally responsible approach to balancing a very complex set of program needs. The fiscal constraints within which we are operating make worthy programs compete for limited funding. This authorization bill recognizes these constraints.

We are proposing to strengthen the energy conservation and renewable energy research programs. The Administration's National Energy Strategy document acknowledges the importance of strengthening conservation and renewable energy R&D. Unfortunately, the Administration's rhetoric was not sufficiently reflected in the Department of Energy's R&D budget request.

Improving our energy efficiency and developing new high-efficiency technologies is absolutely fundamental to meeting America's future energy needs in an economical and environmentally sound manner. Greater energy efficiency, along with expediting the development and deployment of energy-supply technologies based on renewable energy resources is essential for maintaining our international economic competitiveness. Beyond that, energy efficiency and renewable energy are essential for moving us in the direction of an environmentally sustainable energy future.

The substitute amendment I am offering supports the development of alternative fuels and vehicles to reduce our near-total dependence on oil in the transportation sector. The development of these alternatives, including electric vehicles, will enhance the nation's energy security and provide significant environmental benefits.

The amendment also contains support for furthering the development of technologies to enhance the production of our domestic fossil fuel resources. This is consistent with the goals expressed in the Administration's National Energy Strategy.

The amendment supports the development of technologies to enhance our ability to use our domestic resource base of coal in a more environmentally acceptable manner. It specifies an accelerated program for enhanced oil recovery to increase production from domestic reserves and increased efforts for the production and applications of natural gas. These technologies are crucial to meeting our future needs for energy supply and will enhance our energy security by reducing our reliance on imported oil.

The amendment provides support for nuclear energy research and development based on the potential of these advanced nuclear energy technologies for meeting future electricity generating needs. The amendment contains a provision for the "AVLIS" development program -- the Atomic Vapor Laser Isotope Separation uranium enrichment technology that DOE has developed. The goal of this program is to develop and demonstrate a cost-effective method for enriching uranium. This new technology is believed to have the potential to be significantly more economically competitive than the current technology based on gaseous diffusion.

The amendment provides for an assessment of its economic competitiveness and design effectiveness for commercial operation, to expedite the transfer of the AVLIS from the DOE laboratories to the private sector.

We must note that, at this time, nuclear power is facing major hurdles relating both to economics and to unresolved technical and policy issues, including the problems associated with waste management and disposal. The amendment provides funding for research and development related to nuclear waste, which is one of the most difficult challenges to nuclear power, and one for which we have not previously addressed with a coordinated R&D program.

Finally, the amendment supports the DOE request for the fusion energy program, and authorizes funding to continue operation of the Fast Flux Test Facility.

The proposed R&D authorizations we are considering today begin to reflect the directions in which I believe this country needs to move. We need to rebuild the energy conservation and renewable energy programs.

Between fiscal 1979 and fiscal 1989, funding for DOE'S energy conservation R&D programs was cut by 70% in real terms. Since 1989 there has been a moderate reversal of this short-sighted policy of cutting energy efficiency research, but the strengthening we are proposing in this bill still restores just a fraction of what was cut during the Reagan Administration.

There is a tremendous untapped potential for making energy efficiency gains and developing new high-efficiency technologies in every key sector of the U.S. economy. While progress has been made since the days of the oil embargo and the energy price shocks of the 1970s, there is still a long way to go -- in our industrial manufacturing, in the transportation sector, and in residential and commercial buildings. Our European and Japanese trading partners tend to be more competitive in this respect -- they use much less energy to produce a unit of gross national product. This puts the United States at a competitive disadvantage.

Renewable energy R&D fared even worse during the 1980s.

Between 1979 and 1990 renewable energy programs were virtually gutted -- cut by 90% in real terms. Yet, in spite of this misguided trend, renewable energy has made significant progress in technological sophistication and cost reductions.

Now, as the world market for renewable energy is growing, a number of our trading partners, including Germany and Japan, are investing significantly greater shares of their energy research and development budgets in these technologies -- solar photovoltaics, wind energy, hydrogen, and so forth. While we have achieved a technological leadership position, we are in danger of letting our lead slip away and losing our competitive position.

How we produce and use energy is of fundamental importance for the strength of our economy, the security of our energy supply, the quality of our environment, and the legacy we pass on to future generations. Our energy programs of federally supported scientific research, technology development, and public-private sector cooperative demonstration projects to speed commercialization, are all essential to meeting these future needs.

Mr. **Walker**. Mr. Chairman, the legislation this committee is being asked by its subcommittees to support is $356 million over President Bush's request to implement a national energy strategy. Now, maybe more money makes for a better strategy, and I appreciate the desire of this committee to accelerate research and development, but what I don't understand is why, if we can come up with $356 million over the budget, we end up cutting over $100 million of Department of Energy priorities, in particular, the President's own manned-space exploration initiative. At a time when this committee's integrity and relevance are being so blatantly challenged by the appropriators, it seems to me that we should be resolute and firm in our support of the United States' future in space.

In that regard, Mr. Chairman, in an effort to support this bill, I look forward to working with you to restore some initiatives on the floor which will allow the Department of Energy to support our future electrical energy needs and fulfill its existing obligations and commitments to other agencies. The Department of Energy is pleading for our support, and they deserve our leadership.

Thank you, Mr. Chairman.

[The prepared opening statement of Mr. Walker follows:]

HON. ROBERT S. WALKER
OPENING STATEMENT
DOE BILL

MR. CHAIRMAN, THE LEGISLATION THIS COMMITTEE IS BEING ASKED TO SUPPORT IS $356 MILLION OVER PRESIDENT BUSH'S REQUEST TO IMPLEMENT THE NATIONAL ENERGY STRATEGY. NOW, MAYBE MORE MONEY MAKES FOR A BETTER STRATEGY AND I APPRECIATE THE DESIRE OF THIS COMMITTEE TO ACCELERATE R&D.

BUT WHAT I DON'T UNDERSTAND IS WHY, IF WE CAN COME IN $356 MILLION OVER BUDGET, WE END UP CUTTING OVER $100 MILLION OF DOE PRIORITIES--IN PARTICULAR THE PRESIDENT'S OWN MANNED SPACE EXPLORATION INITIATIVE.

AT A TIME WHEN THIS COMMITTEE'S INTEGRITY AND RELEVANCE IS BEING SO BLATANTLY CHALLENGED BY THE APPROPRIATORS, IT SEEMS WE SHOULD BE RESOLUTE AND FIRM IN OUR SUPPORT OF THE U.S.' FUTURE IN SPACE.

IN THAT REGARD, MR. CHAIRMAN, IN AN EFFORT TO SUPPORT THIS BILL, I LOOK FORWARD TO WORKING WITH YOU TO RESTORE SOME INITIATIVES ON THE FLOOR WHICH WILL ALLOW DOE TO SUPPORT OUR FUTURE ELECTRICAL ENERGY NEEDS AND FULFILL ITS EXISTING OBLIGATIONS AND COMMITMENTS WITH OTHER AGENCIES. DOE IS PLEADING FOR OUR SUPPORT AND THEY DESERVE OUR LEADERSHIP.

The **Chairman**. I appreciate the gentleman's remarks, and I have assured him privately and I will assure him publicly that we will continue to seek to make additional changes in this bill which will bring it closer to the views that he has expressed, and I am confident that we'll be able to do that.

The Chair recognizes the chairman of the Environmental Subcommittee, Mr. Scheuer, for his portion of the subcommittee report on this bill.

Mr. **Scheuer**. Thank you, Mr. Chairman.

Mr. Chairman, I wish to commend you most heartily for structuring a comprehensive and fiscally responsible legislative proposal for the committee's programs within the Department of Energy's energy supply research and development accounts. The substitute amendment before the members takes a strong position with regard to the level of investment our Nation must make in conservation and in renewable energy if our energy supply portfolio is to remain strong.

The National Academy of Sciences, in its recent report confronting climate change, says that expenditures for technologies based on solar and renewable sources and energy efficiency should account for 20 percent of the Nation's energy supply R&D budget. The Administration's fiscal year 1992 request for these programs represents only a 13 percent share. The Brown amendment redresses that inequity by increasing funding for those programs.

Committee members should note that many of the technologies represented on the White House list of 22 technologies deemed critical to U.S. competitiveness are represented in this budget. They include ceramics composites, energy technologies, pollution and waste minimization, surface transportation, materials synthesis and processing, high-performance metals, applied molecular biology, and medical technology.

Mr. Chairman, I look forward to working with you to bring this excellent energy package to the House floor.

The **Chairman**. The Chair thanks the gentleman from New York for his comments and recognizes the ranking Republican member of that subcommittee, Mr. Ritter.

Mr. **Ritter**. Thanks, Mr. Chairman.

I want to commend you and the subcommittee chairman, Mr. Scheuer, and Mrs. Lloyd, as well as Mr. Walker and Mr. Morrison, the ranking Republican on the Energy Subcommittee, for your efforts in assembling this energy authorization.

The bill is a concrete step toward development of a responsible, fiscally and environmentally sound energy strategy to help decrease our Nation's reliance on imported oil, and I am also of the belief that prudent energy conservation provides for more efficient use of all of our resources and has a signal effect on our Nation's economic well-being and competitiveness. Conservation pays, basically.

The bill before us today recognizes that no one single technology is going to be the answer to our energy dilemma, and we need to focus our R&D efforts on a mix of resources that can be harnessed in an efficient, productive, and environmentally acceptable manner. The bill proposes funding for programs which are essential components for this mix.

The Environment Subcommittee took action to restore funding toward levels of the early 1980s in programs within its jurisdiction, including R&D, to reduce uncertainties associated with renewable energy and move forward toward greater use of these resources in R&D in energy conservation and greater energy efficiency. As the President's national energy strategy notes, conservation efforts are especially beneficial. They enable us to make better use of the energy we already have, thus reducing energy costs to consumers and making industry more competitive, while helping us as a Nation to break away from our great appetite for energy—sometimes dangerous appetite, I might add.

One promising conservation effort is the metals initiative encompassing R&D efforts to save energy in the steel and aluminum industries. Once again, energy efficiency goes hand in hand with economic competitiveness and environmental quality.

Mr. Chairman, I support an energy R&D portfolio which features enhanced renewables and conservation programs. I also support measures taken by the Energy Subcommittee to fund R&D in promising energy technologies, including an enhanced effort to develop advanced, standardized nuclear reactors. Nuclear power has enormous potential to be a safe, clean, and abundant source of energy.

Mr. Chairman and my colleagues, you know that the nuclear option is on its way back when the only announced candidate for the Democratic nomination for Presidency is supporting nuclear power and is running on a pro-nuclear power platform. Perhaps this can help to allay some of the public concerns with nuclear energy.

Mr. Chairman, I look forward to working with you in moving forward this package toward consideration by the full House.

I also want to associate myself with the comments made by the ranking member on propulsion systems for extended space exploration and hope that we can work out the appropriate language on the way to the floor of the House.

I yield back the balance of my time.

The CHAIRMAN. Thank you very much.

The Chair now recognizes the gentlelady from Tennessee, Mrs. Lloyd.

Mrs. LLOYD. Thank you very much, Mr. Chairman.

I, too, want to take this opportunity to thank you, Chairman Brown, for your leadership as well as your statesmanship in bringing this energy technology research and development bill before this full committee. Indeed, this is a great day for the committee, and, as you stated earlier, it's a great step forward. We realized that there would be some adjustments that would have to be made when two energy bills were combined or married and reported for the full committee, and I do commend you, Mr. Brown, for making these adjustments as well as we have. It certainly took diplomacy on your part to bring about this consensus, and you've clearly displayed a wisdom of Solomon.

I do believe the Subcommittees on Energy and Environment have presented the committee with a responsible proposal—not perfect, but it is responsible—because the energy bill that we have before us today has balance. We've provided strong foundations for the R&D programs for conservation, for renewables, for fossil, as well as nuclear, and all of these technologies must be pursued if we're going to achieve a broad-based energy mix that will help us to meet the challenges of the coming 21st century.

We on the Science Committee know full well that one can never predict where the next great development will come from, and so with that knowledge, we must steadfastly pursue all of the reasonable opportunities that we have for energy research and development.

I thank you, Mr. Chairman.

[The prepared opening statement of Mrs. Lloyd:]

HONORABLE MARILYN LLOYD

OPENING STATEMENT

MAY 22, 1991

I WANT TO TAKE THIS OPPORTUNITY TO THANK CHAIRMAN BROWN FOR HIS LEADERSHIP AND HIS STATESMANSHIP IN BRINGING THE ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT BILL BEFORE THE COMMITTEE.

THE SUBCOMMITTEE ON ENERGY, IN ITS DELIBERATIONS, ESTABLISHED ITS PRIORITIES WITHIN THE BUDGET FRAMEWORK PROVIDED BY THE FULL COMMITTEE. WE REALIZED THAT SOME ADJUSTMENTS WOULD HAVE TO BE MADE WHEN THE TWO ENERGY BILLS WERE COMBINED FOR REVIEW BY THE FULL COMMITTEE. I COMMEND CHAIRMAN

BROWN FOR MAKING THESE ADJUSTMENTS RELATIVELY PAINLESS. IT TOOK CONSIDERABLE DIPLOMACY ON HIS PART TO BRING ABOUT THIS CONSENSUS.

I BELIEVE THE SUBCOMMITTEES ON ENERGY AND ENVIRONMENT HAVE PRESENTED THE COMMITTEE WITH A RESPONSIBLE PROPOSAL. THE ENERGY BILL BEFORE US TODAY HAS BALANCE. WE HAVE PROVIDED STRONG FOUNDATIONS FOR THE RESEARCH AND DEVELOPMENT PROGRAMS FOR CONSERVATION, RENEWABLES, FOSSIL, AND NUCLEAR. ALL OF THESE TECHNOLOGIES MUST BE PURSUED TO ACHIEVE A BROAD-BASED ENERGY MIX WHICH WILL MEET THE CHALLENGES OF THE COMING 21ST CENTURY.

WE ON THE SCIENCE COMMITTEE KNOW FULL WELL THAT ONE CAN NEVER PREDICT FROM WHERE THE NEXT GREAT

DEVELOPMENT WILL COME. WITH THAT KNOWLEDGE, WE MUST STEADFASTLY PURSUE ALL REASONABLE OPPORTUNITIES FOR ENERGY RESEARCH AND DEVELOPMENT.

The Chairman. The Chair recognizes the gentleman from Washington, Mr. Morrison.

OPENING STATEMENT OF HON. SID MORRISON, MEMBER, SUBCOMMITTEE ON ENERGY

Mr. Morrison. Thank you, Mr. Chairman.

It's interesting as we have gone through this authorization markup process that the budget agreement really does bring fiscal arguments down to the subcommittee level more than many of us are used to, and so I want to add my voice and thanks to our Chairman and certainly to my subcommittee chairman, Mrs. Lloyd, for an excellent balancing act.

These subcommittee reports do reflect the personality of the subcommittees, and yet I like to think as we bring you the energy report that it is blended with the real energy world's needs. We've made every effort to do that.

I also thank Chairman Brown because he will be offering a substitute as part of this discussion that further refines our efforts to bring the two subcommittees represented here, both Environment and Energy, together.

I also would point out we still have some details to work out reflecting some vital concerns of the Department of Energy, some of their priorities, and I'll have more to say about that when we get into the section dealing with amendments.

Thank you, Mr. Chairman.

The Chairman. Thank you very much, Mr. Morrison.

Now, for a second opinion, the Chair recognizes Mr. Wolpe. [Laughter.]

OPENING STATEMENT OF HON. HOWARD WOLPE, MEMBER, SUBCOMMITTEE ON ENERGY

Mr. Wolpe. Thank you very much, Mr. Chairman.

I was going to begin by also commending you on your extraordinary accomplishment this year in putting together the substitute that you'll be offering in just a moment.

As you know, I was prepared to offer a major amendment to the DOE authorization bill before us. I was concerned that the final bill reported from the committee would contain huge increases in nuclear energy research and development at the expense of energy efficiency and renewable energy programs. However, I'd like to indicate my support for the Chairman's substitute that we will be considering in a moment. In my view, it is a step toward a more balanced and rational energy research and development policy, and by agreeing to support the Chairman's alternative, I will be refraining from offering any amendments to this package.

I would, however, like to reserve the option to offer amendments to this package at some future date. My concerns center in particular on the Advanced Nuclear Program, the AVLIS Program, the SP100 Program, and the Reduced Enrichment Research and Test Reactor Program. While this bill is a step in the right direction, I believe that we still have a long way to go. We're in the midst of a period of severe fiscal constraints and increased concern about energy security. This situation demands fiscal discipline, and with such limited resources, we simply can't tolerate research and development spending that lacks merit.

I submit that we should be making some effort to systematically match energy research and development spending with national energy goals. While this makes simple common sense, it's not the way our Government generally operates. From my experience, priorities are more typically established not by employing objective criteria or measurements of evaluation, but in response to parochial concerns or special interest pressures.

The nuclear energy research and development budget is the best example of this disparity between stated energy policy goals and actual R&D spending priorities. This can be seen by taking a look at the Administration's own national energy strategy. The chapter entitled "Enhanced Research and Development for Energy Security" begins with this passage, and I quote: "One of the keys to ensuring future energy security is reducing U.S. oil vulnerability. Technological advancements are one of the best ways to achieve this. The national energy strategy calls for increasing investments for technology research and development in the areas with the greatest potential for reducing oil vulnerability."

I could not agree more, but if you take a closer look at the Administration's priorities for enhanced R&D, you'll notice that the largest chunk, approximately $1.2 billion over the next five years, would be spent in two nuclear energy R&D programs. I asked the Department of Energy to indicate how much oil would be displaced by each of the Administration's 12 enhanced energy R&D initiatives, and this is the response of the Department: "The two nuclear options reports in the President's budget are not included, because no oil savings are expected from these options since little oil is used in electricity generation now, and even less oil use is expected in the future."

While the Administration claims that we should be increasing investments in areas with the greatest potential for reducing oil vulnerability, their own analysis indicates that their top energy R&D priorities will not displace any petroleum whatsoever. I'm forced to conclude that the Administration is less concerned with energy security than rescuing a dying industry. The Administration's own best case projections indicate that if it were left to market forces, nuclear power plants would cease to produce any energy in America in the year 2030.

During a hearing of the Energy Subcommittee, I asked the Assistant Secretary for Nuclear Programs why the Administration was targeting such huge sums to nuclear R&D. He replied that such support was necessary so that nuclear energy could compete on a level playing field with other technologies. In light of the billions of dollars in Federal subsidies lavished upon the nuclear industry since the Atoms for Peace Program, that was a truly astounding observation.

When pressed further to justify the national energy strategy's heavy emphasis on nuclear energy, the Assistant Secretary indicated that they had documentation to indicate what they had argued in their national energy strategy statement. Despite repeated requests, however, I have yet to receive any data from the Department of Energy justifying their decision to make the resuscitation of the nuclear industry one of the primary objectives of the national energy strategy.

I would like at this point, Mr. Chairman, to ask unanimous consent that the remainder of my statement be included in the record.

The CHAIRMAN. Without objection, so ordered.

Mr. WOLPE. Thank you.

The CHAIRMAN. The Chair appreciates the comments of the gentleman and recognizes the great deal of work that he's done in analyzing this problem. It will be a major issue before this committee for some time, determining the proper role of the various energy strategies, and I indicated in my own opening remarks that I'm not fully satisfied with all of the details of this, but I am convinced that we are taking a strong step in the right direction, and I want to encourage us to continue in that direction.

Are there additional comments before we have a motion to adopt the committee report?

[No response.]

The CHAIRMAN. If not, a motion is in order to adopt the committee report.

Mr. RITTER. Mr. Chairman.

The CHAIRMAN. Mr. Ritter.

Mr. RITTER. Mr. Chairman, I move the adoption of the reports of the Subcommittee on Energy and the Subcommittee on Environment on H.R. 2399, the Energy Technology Research and Development Act of 1991.

-DRAFT-

ENERGY TECHNOLOGY RESEARCH AND DEVELOPMENT AUTHORIZATION ACT FOR FISCAL YEAR 1992 AND FISCAL YEAR 1993 FOR THE DEPARTMENT OF ENERGY CIVILIAN RESEARCH AND DEVELOPMENT PROGRAMS

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I. INTRODUCTION

The objective of the Energy Technology Research and Development Act is to provide funds for Fiscal Year (FY) 1992 and FY 1993 for the conduct of research and development of energy technology programs. This authorization act is limited to research and development funded through the Department of Energy (DOE) and within the sole jurisdiction of the Subcommittee on Energy.

In addition to the operating, equipment, and General Plant Projects (GPP) and minor construction funds, this act also addresses the authorization of substantial construction projects and major construction projects, and as appropriate, stipulates the requirements placed upon the DOE to submit future construction projects for authorization approval.

Finally, this act addresses a number of policy issues related to the conduct and oversight of energy research and development programs. These include the authorization of construction projects, budget submissions and cost sharing as well as other issues. As appropriate, the act requires the DOE to provide reports to the Congress.

II. FINDINGS

The Subcommittee finds that:

1. The development of new energy technologies is a necessary step in reducing oil imports and providing for our Nation's energy needs in the 21st Century.

2. The development of efficient, economic, safe, and environmentally acceptable energy technologies is a necessary part of an effective National Energy Strategy.

3. Technological advances in the recovery and use of our fossil fuel resources will provide time for an orderly transition to other energy sources while at the same time reducing our vulnerability to supply disruptions, price escalations and the environmental side effects of fossil fuel use.

4. Technology development occurs over a time span that is often measured in years or even decades; therefore, commitments to new energy technology development must be consistent with these time requirements and cannot be made on a year to year basis.

III. HEARINGS

The Subcommittee on Energy held hearings on the Fiscal Year 1992 DOE authorization request for the following research and development programs: Fossil Energy; Nuclear Energy; Fusion Energy; Oil & Gas; Basic Energy Sciences; and the Atomic Vapor Laser Isotope Separation Research and Development Program. The hearings were held on March 5, 6, 13, 14, 19, and April 10, 1991.

Department of Energy officials who testified included: Honorable Robert Gentile, Assistant Secretary for Fossil Energy; Honorable William H. Young, Assistant Secretary for Nuclear Energy; and Dr. James Decker, Director, Office of Energy Research.

In addition, the following citizens testified: Mr. Frank Burke, National Coal Association; Mr. Gary Styles, Manager, Advanced Fuels Utilization, Southern Company Services; Mr. Lawrence J. Wisdom, Vice President, HRI, Inc.; Mr. Donald Peebles, President and Chief Executive Officer, Montana Technology Companies; Mr. Frank Schora, President and Chief Executive Officer, M-C Power Corporation; Dr. Jack Sanderson, Asea Brown Boveri Incorporated; Mr. Walt Dollard, Westinghouse Electric Corporation; Mr. Arnold Aldrich, Associate Administrator, National Aeronautics and Space Administration; Dr. Shelby T. Brewer, President, Nuclear Business, Combustion Engineering; Mr. Nathanial Woodson, Vice President, Energy Systems, Westinghouse Hanford Company; Dr. Bertram Wolfe, Vice President, General Electric; Mr. Patrick McDonald, Executive Vice President, Southern Nuclear Operating Company; Dr. Charles Till, Associate Director, Argonne National Laboratory; Mr. Linden Blue, Vice Chairman of the Board, GA Technologies; Dr. Alex Zucker, Associate Director, Nuclear Technology, Oak Ridge National Laboratory; Mr. Jeff Breckel, Special Assistant to the Governor, State of Washington; Mr. Roger Nichols, Deputy General Manager, Government Operations, Westinghouse Hanford Company; Dr. Ronald C. Davidson, Director, Princeton Plasma Physics Laboratory; Dr. Ron Parker, Director, Fusion Laboratory, Massachusetts Institute of Technology; Dr. Roger Bangerter, Group Leader, Heavy Ion Fusion Accelerator Research Division, Lawrence Berkeley National Laboratory; Dr. David Overskei, Senior Vice President, Fusion Division, GA Technologies; Dr. Harold Forsen, Vice President, Research and Development, Bechtel Power Corporation; Dr. Stephen O. Dean, President, Fusion Power Associates; Dr. Alex Glass, Associate Director for Programs, Lawrence Livermore National Laboratory; Mr. George E. Strang, Vice President for Engineering and Operating Support, Southern California Gas; Mr. David O. Webb, Vice President, Gas Research Institute; Dr. Bernard Lee, President, Institute of Gas Technology; Dr. Thomas A. Hyde, Chairman and Professor of Engineering, University of Texas; Mr. James Deterding, Vice President and Director, National Institute for Petroleum and Energy Research; Dr. Frank Derbyshire, Director, Center for Applied Energy Research, University of Kentucky; Dr. Marcus H. Voth, Director, Radiation Science & Engineering Center, Pennsylvania State University; Dr. Barclay G. Jones, Professor and Head, Department of Nuclear Engineering, University of Illinois; Dr. Frank Y. Fradin, Associate Laboratory Director, Physical Research, Argonne National Laboratory; Dr. Martin Blume, Deputy Director, Brookhaven National Laboratory; Dr. Michael Knotek, Senior Science Director, Pacific Northwest Laboratory; Dr. Jay N. Marx, Director, Advanced Light Source, Lawrence Berkeley Laboratory; Dr. David E. Moncton, Associate Laboratory Director, Advanced Photon Source, Argonne National Laboratory; Dr. B.R. Appleton, Associate Director, Physical Sciences and Advanced Materials, Oak Ridge National Laboratory; Mr. Robert M. Bernero, Director, Office of Nuclear Material Safety and Safeguards, Nuclear Regulatory Commission; Mr. Victor S. Rezendes, Director of Energy Affairs, General Accounting Office; Dr. James I. Davis, Associate Director for Lasers, Lawrence Livermore National Laboratory; Dr. Robert Merriman, Vice President, Applied Technology, Martin Marietta Energy Systems, Inc.; Mr. E. J. Miles, Director, Fuel Cycle Materials and Service Department, Westinghouse Electric Corporation.

IV. EXPLANATION OF SUBCOMMITTEE ACTIONS

A. Energy Supply Research and Development

1. Supporting Research and Technical Analysis

Supporting Research and Technical Analysis is a broad area of research and related activities that includes four programs plus advisory and oversight functions. The research activities include Basic Energy Sciences, Energy Research Analyses, University and Science Education, and Multiprogram Energy Laboratory Facilities Support. In addition, Advisory and Oversight Program Direction is provided. The primary program in terms of funding and scope within Supporting Research and Technical Analysis is the Basic Energy Sciences.

The Fiscal Year 1991 funding and the DOE budget request for FY 1992 funding by program are provided below:

Table 1

Supporting Research and Technical Analysis
($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
Basic Energy Sciences	$711.8	$714.7
Energy Research Analysis	$3.7	$4.0
University and Science Education	$46.6	$48.9
Advisory and Oversight	$4.2	10.1
Multiprogram Laboratory Facilities Support	$23.6	$23.9
Total	$789.9	$801.6

Discussion of each of the major programs and the major policy issues follows.

a. Basic Energy Sciences

Program Description

The Basic Energy Sciences (BES) program is composed of six major technical subprograms which correspond to distinct but often related areas of scientific investigations. These subprograms include: Materials Sciences, Chemical Sciences, Applied Mathematical Sciences, Engineering and Geosciences, Energy Biosciences, and Advanced Energy Projects. Each of the program areas fund research at the national laboratories and at universities and other government and private research facilities. The percentage of funds expended at the national laboratories versus the universities varies significantly for each of the subprograms.

Table 2

Basic Energy Sciences

Funding History
($ in Millions)

Fiscal Year	Actuals
1978	$180.4
1979	$204.7
1980	$223.1
1981	$227.5
1982	$241.2
1983	$282.4
1984	$335.5
1985	$412.5
1986	$419.9
1987	$519.5
1988	$557.7
1989	$545.9
1990	$564.1
1991	$711.8

In FY91 the Basic Energy Sciences (BES) program received an appropriation of $711.8 million; for FY92 the Department has requested $714.7 million. Table 3 below provides a breakdown by major subprogram and also identifies funding used to support the operation of User Facilities, a rapidly increasing funding commitment. Basic Energy Sciences research projects provide the research knowledge base not only for energy technology developments, but often lead to breakthroughs in waste cleanup technologies. These breakthroughs have the potential to reduce the cost of cleaning up DOE facilities by billions of dollars.

Table 3

Basic Energy Sciences Funding
($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
Materials Sciences	274.9	257.1
Facilities Operations	(77.6)	(100.4)
Chemical Sciences	157.6	158.3
Facilities Operations	(58.1)	(60.3)
Applied Mathematics	52.7	75.5
Engineering Research/ Geosciences	34.3	35.8
Advanced Energy Research	24.8	10.8
Energy Biosciences	22.0	24.7
Program Direction	6	7.5
Subtotal Operations	572.5	569.7
Facilities Operations	(135.7)	(160.7)
Capital Equipment	36.8	37.0
Construction	102.4	108.0
Total BES	711.8	714.7

Materials Sciences

The Materials Sciences subprogram seeks to improve our theoretical and experimental capability to analyze the fundamental structure and behavior of materials. The result of this research often leads either to the development of advanced materials with unique properties (e.g. corrosion resistance or strength) or the development of processes to make existing materials more efficiently. This research is of special significance to high temperature superconductivity, condensed matter physics, metallurgy and ceramics. The pace of technology advancements is increasing in this highly competitive field. In the United States there is growing interest in coordinating the national efforts in this area into a materials sciences initiative involving the national laboratories, other government laboratories, the university community and the private sector.

In addition to funding research projects, the BES Materials Sciences subprogram is one of the principal funding sources for unique scientific and technical capabilities and facilities in the United States, such as, the electron microscope at the Lawrence Berkeley Laboratory which is capable of imaging individual atoms.

These major facilities (referred to as "user" facilities) are made available for experiments conducted by the national laboratories, other government, private, university and industry laboratories, the international science community, and industry. Because of the cost of building and maintaining these facilities and their importance to science and technology, the time available to users is allocated on a merit basis determined by a panel of peers who review and prioritize proposals. Due to the unique capabilities of these facilities, there are always more proposals than available machine time can accommodate.

Several of the user facilities in the United States were built in the 1950s and 1960s and are approaching the limit of their useful life or are no longer considered world class facilities. Recognizing the essential role of these facilities in technology development (especially in materials, chemistry, geology, and biology), the U.S. has begun a major upgrade program in an effort to make facilities competitive with those in Europe and Japan. Two new light sources (one for materials surface analysis and gas spectroscopy, and the other for materials structural analysis) are under construction. The Advanced Light Source (ALS) will be completed in FY 1993 and the Advanced Photon Source (APS) will be completed in 1996. Both will provide capabilities essential for technology development by American industry as well as supporting the basic sciences and the research needs of the laboratory community.

The U.S. neutron beam facilities are also aged, having been commissioned in the mid 1960s. The DOE has proposed building a new neutron facility which is presently undergoing conceptual design and safety analysis; if this project proceeds as planned, the Advanced Neutron Source will formally become a construction project in 1993. This facility, which could be completed around 2001, would replace the High Flux Isotope Reactor (HFIR) and High Flux Beam Reactor (HFBR) both of which will be approaching 40 years of age at that time. Expert witnesses appearing before the Subcommittee have stated that the existing facilities (HFIR/HFBR) are beginning to show signs of neutron embrittlement and estimate their useful life at between 10 and 15 years from today.

Neutron facilities are an essential tool in the study of lighter elements, such as carbon and hydrogen, which are used in polymers and organic substances. In addition, neutron beams complement the analysis performed by light sources; using both neutron and X-ray analysis yields the maximum information regarding the structure, composition and characterization of materials. The investment in new user facilities is well timed to support growing interest in a national initiative in the materials science and research area.

Chemical Sciences

The Chemical Sciences subprogram investigates the chemical properties of matter and the interactions of component molecules, atoms, ions and electrons. Advances in knowledge are often applicable to the extraction of fuels and chemicals from coal, nuclear waste separation, biomass conversion to liquid fuels, and detection and measurement of harmful products from energy processes.

This area of scientific investigation has become increasingly important in providing basic research and knowledge of particular significance to the ultimate development of waste cleanup technology. The Subcommittee believes that investment in chemical sciences may lead to major technological breakthroughs in waste cleanup methods. These breakthroughs could save the DOE billions of dollars in providing cleanup techniques that are both less costly and more effective. In addition, it could result in savings for U.S. industry of hundreds of billions of dollars in its efforts to clean our environment.

Applied Mathematical Sciences

The Applied Mathematical Sciences subprogram supports all aspects of mathematical and computational research. The subprogram also provides access to expand the capabilities of the DOE's super computing facilities used by national laboratory and outside researchers supported by the DOE research programs.

A significant portion of the FY 1992 funding ($28 million) is provided for support of the High Performance Computing and Communications (HPCC) Initiative. The HPCC capability is an important element in maintaining U.S. competitiveness in most fields of science and technology. Funds will provide for research, assessment, and the development of new computer architectures used for computation and modeling.

Engineering and Geosciences

Two broad disciplines are included in the Engineering and Geosciences subprogram. Research in engineering seeks to expand our knowledge of processes and concepts that underlie current engineering practice. This knowledge provides a broadened technical base for solving engineering problems related to energy technologies. Projects deal with our basic understanding of basic, but important, topics such as, the flow of oil, gas and water through porous materials such as soil or rock. The knowledge gained in this type of research serves as a basis for development of enhanced oil recovery techniques.

Geosciences research emphasizes the development of the productive understanding of the energy related aspects of geological, geophysical and geochemical processes. High resolution underground imaging is one of the important projects carried out in the Geosciences activity.

Advanced Energy Projects

The Advanced Energy Projects Subprogram explores the feasibility of novel energy related concepts which emerge from basic research but are not sufficiently defined and understood to move forward into technology development. Several projects are on-going and will continue into FY 1992; these include innovative techniques for oil spill cleanup, unconventional fossil fuel technology, and processing techniques for high temperature superconducting materials. New projects are constantly moving into this subprogram as more mature projects are moved into technology development or set aside when not of sufficient promise to continue.

Subcommittee Recommendations

The Subcommittee supports the DOE funding request for Basic Energy Sciences in FY 1992 of $714.7 million, which includes funding for the completion of the construction of the Advanced Light Source (ALS) and continued construction of the Advanced Photon Source (APS). The Subcommittee strongly supports the budget request for the Molecular Science Research Center (MSRC). The Subcommittee also supports the upgrading of our Nation's user facilities. At the same time, the Subcommittee observes that once having constructed these facilities, we will then assume the obligation to operate and maintain them. The cost of this obligation is increasing rapidly because of the start-up of new facilities and the greater emphasis on environment and safety requirements which are essential, but add to the costs of operating these facilities.

The FY 1992 budget request for facilities operations increased significantly and now is approaching 40 percent of the Materials Sciences budget; similar levels are experienced in the Chemical Sciences budget. The Subcommittee is concerned that funds for the operation of these facilities will be obtained at the expense of the base research program. This would be unfortunate.

Within the Basic Energy Sciences program, a sum of $1.6 million is authorized to fund a continuing research and development program at the Industrial Technology Institute. The Institute will utilize a Manufacturing Needs Tool previously demonstrated to inform laboratory personnel of manufacturing needs and identify laboratory-based technologies for technology transfer through further development and commercialization. The Subcommittee supports the work of the Institute and directs the Department to continue funding the activity.

The Subcommittee recommends that the FY 1993 authorization provide funds for the rapid increases of facilities operations and that moderate levels of growth be provided for the base research program.

Table 4

Basic Energy Sciences

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
BES/Operating Expenses	$569.7	$633.6
(Facilities Operations)	($160.7)	($196.0)
BES/Capital - Equipment/Construction	$145.0	$202.9*
Total	$714.7	$836.5

*Includes construction authorization in FY 1993 of $38.9 million for the ANS and $120.5 million for the APS.

In providing for the FY 1993 increase in authorization for the Basic Energy Sciences program, the Subcommittee recognizes the importance of these activities in providing the knowledge base for future energy technology developments and for the contribution to broader technology advances. While the Subcommittee believes all of the areas of investigation are important, advances in materials sciences and engineering technologies are of special significance at this time.

The Subcommittee recommends that the FY 1993 funding level for BES be authorized at $836.5 million. This includes $633.6 million for operating funds, $38.5 million for equipment and $164.4 million for construction, including funds for the General Plant Projects (GPP), Advanced Neutron Source (ANS), and Advanced Photon Source (APS); this will provide for the base research program and the operation of user facilities.

The Subcommittee believes that with the completion of the Advanced Light Source in FY 1992 the DOE should move forward with the Advanced Neutron Source and initiate construction of this project in FY 1993. This will be the final step in upgrading the national laboratory X-ray and neutron capabilities. The FY 1993 authorization of $836.5 million for BES includes $38.9 million for initial construction activities for the ANS and $120.5 million for continuation of the APS. The Subcommittee authorizes funds in the amount of $93.0 million for FY 1994; and $45.0 million for FY 1995 for completion of construction of the APS.

Program Balance

The Subcommittee is concerned that the balance between the resources committed to research and scientific investigations and those required for the operation of user facilities at the national laboratories is entering a period of rapid change.

The construction of new user facilities is a major BES program objective for the 1990s. The Subcommittee believes these capabilities are essential if U.S. capabilities in science and technology development are to maintain their relative position with our competitors. However, once having put these facilities in place, the BES program (the Materials Sciences subprogram in particular) assumes the responsibility to operate and maintain them. This places a significant financial commitment on the program. If cost of living adjustments are the only increases provided to this program, then new user facilities can only be operated at the expense of the basic research program.

The Subcommittee is concerned that we may be embarking on a course of action that places our Nation in the position of having to choose between competitive user facilities (tools of science) or a basic research program, but does not provide for both. In the opinion of the Subcommittee, placing the program in such a dilemma guarantees a mediocre outcome. To address this potential problem, the Subcommittee recommends out-year authorization levels that provide for continuation of the basic research program and the operation of new user facilities.

User Fees

In the Omnibus Budget Reconciliation Act of 1990, P.L. 101-508, the DOE was directed to undertake a review of its user fee policies. The Subcommittee awaits with interest the findings of the DOE and any recommendations it may propose.

With history as a guide, however, the Subcommittee recognizes that past efforts to raise significant revenue through changes in user fees have been unsuccessful. Given our concerns over the ability of American industry to develop new technology to effectively compete in world markets, major increases in user fees could be counter-productive. In the face of the results of our past efforts to generate revenues through user fees and our national interest in a more cooperative technology development posture between government and industry, the Subcommittee does not believe that changes in user fee policy are a realistic method of addressing the program balance issue raised above. And while not wishing to prejudge the findings of the DOE, the Subcommittee will examine very carefully any proposal which essentially changes the nature of User Facilities at the national laboratories.

Participation of Historically Black Colleges and Universities (HBCU) in BES Programs:

A significant portion of the BES program funds are used to support scientific investigation and research at colleges and universities. The Subcommittee has found that HBCU have had little, if any, participation in these programs. In its hearings, the Subcommittee was informed that such institutions are "at a great disadvantage in competing for such grants." In effect, they face a "chicken and egg" problem. Without scientific faculty members of national stature, HBCU are unlikely to be successful in competing for BES grant awards; yet, without a grant (or a large endowment) HBCU cannot attract this caliber of faculty who are in high demand nationally. Consequently, these schools have little hope of breaking into this circle and establishing themselves in one of these science fields.

The Subcommittee recognizes that despite the fact that demographic trends show that minorities will be the primary source of scientific and engineering talent in the next decade, little effort is being made to encourage HBCU to participate in these programs. Given the population trends, the Subcommittee believes it is prudent to take measures to provide opportunities for HBCU to develop their faculty resources, and thereby student talents, through participation in BES grant programs.

The Subcommittee directs the DOE to provide to the Congress, within six months after enactment, a plan to encourage HBCU to submit proposals for BES grants and to provide opportunities for these institutions to successfully compete for such grants. Given the exemplary record of the DOE in creating innovative science and engineering educational programs for minorities, the Subcommittee is confident that the DOE will develop an effective plan for addressing this issue.

New Construction Projects

Given the Subcommittee's concern for maintaining program balance between the basic research program and support for user and other facilities, the Subcommittee believes that greater attention must be given to the initial decision to undertake such construction projects. In particular, the Subcommittee believes that both the total project cost and the commitment to additional operating costs must be carefully weighed. Therefore, the Subcommittee requires that before new construction projects in excess of $10 million can be undertaken they must be authorized in their entirety by the Congress; construction projects over $100 million are classified as major construction projects. Both categories are discussed in Section V.

b. Energy Research Analyses

The Energy Research Analyses Program carries out technical assessments on DOE civilian research and development programs and projects. These analyses provide comprehensive evaluations of the programs and identify new directions that future research and development programs should take to be more productive and relevant to DOE missions.

The Subcommittee believes this program provides an important capability and recommends that it be authorized in FY 1992 and 1993.

The Subcommittee authorizes $4.0 million for FY 1992 and $4.2 million for FY 1993 for Energy Research and Analyses.

c. Multiprogram Energy Laboratories - Facilities Support

This program provides funding for timely rehabilitation and replacement of general purpose facilities at the Energy Research Laboratories. The projects are intended to combat problems associated with aging and obsolescence; in addition, it provides funds for the Office of Energy Research to correct environment, safety and health inadequacies at multiprogram laboratory facilities that require immediate attention.

The Subcommittee is concerned that the age of laboratory facilities and the requirements to bring these facilities into compliance with environment, safety and health regulations could combine to escalate the demand for funds for this activity. In order to provide a background for understanding such needs, the Subcommittee requests that DOE provide relevant historical information regarding the age of these facilities, their condition, and investment history, such as, dollars per square foot for rehabilitation, replacement or other activities required to adequately maintain these facilities. The Subcommittee also requests that long range projections of the future funding requirements for this program be provided with appropriate explanation of deviations from existing trends.

The Subcommittee authorizes $23.9 million for FY 1992 and $24.9 million for FY 1993 for laboratories facilities support.

d. Advisory and Oversight Program Direction and Policy Management

The Subcommittee authorizes $10.1 million for FY 1992 and $10.5 million for FY 1993 for Advisory and Oversight Program Direction and Policy Management. The FY 1992 funding request will provide staffing required by the Director of Energy Research to carry out his responsibilities, including support for the Secretary of Energy Advisory Board.

e. University and Science Education

Program Description

The DOE is broadening its effort to address some critical areas, including pre-college programs and programs to attract minorities and women to the fields of science, engineering and mathematics. While DOE and its predecessors have long had a relationship with the academic community, these programs traditionally were designed to meet the needs of the graduate level and post doctoral level.

The dedication of DOE to science and mathematics education is commendable. The Subcommittee strongly supports efforts to enhance and expand these programs.

The Nuclear Engineering Research and Education Program was created by Congress in FY 1988 under the Laboratory Cooperative Science Centers to provide support for university based nuclear engineering research and education programs. The program awarded, through peer review, competitive projects for both graduate research fellowships and laboratory/university research projects.

The University Research Reactor Program has been a part of DOE and its predecessors since the early 1950s, when the first university reactor became operational at North Carolina State University in September 1953. Although this program was established for education and research related to nuclear science, technology, and radiochemistry, the reactors have since become a multi-disciplinary tool involving physics, chemistry, biology, medicine, and materials sciences.

While originally set up to conduct education and research, the current research reactors rely on the University Research Reactor Program for much needed upgrades. The Subcommittee has found that as DOE has moved these programs from one budget area to another, they have suffered. Today, the number of colleges and universities which offer any curriculum in nuclear engineering and related technologies is declining. This is particularly worrisome because the Federal government and DOE in particular are among the largest employers of nuclear graduates, and it is, therefore, appropriate that they sponsor these important programs.

Table 5

University and Science Education

Funding History

($ in Millions)

Includes Nuclear Engineering Research/
Education and University Research Reactor Programs

FY81	$13.2
FY82	$11.9
FY83	$ 7.6
FY84	$10.9
FY85	$20.1
FY86	$20.8
FY87	$24.7
FY88	$30.2
FY89	$34.4
FY90	$38.8
FY91	$46.6

Table 6

University and Science Education

($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
University and Science Education	$40.6	$47.9
Nuclear Engineering Research and Education	$5.0	0*
University Research Reactors (upgrades)	$1.0	$ 1.0
Total	$46.6	$48.9

*The DOE has stated that the Nuclear Energy budget requests $2.5 million for this program, but it also attempts to move the program out of the university education program.

Subcommittee Views

The Subcommittee applauds the foresight of the Secretary of Energy in recognizing the importance of "fortifying foundations" as a critical element of our National Energy Strategy. The DOE support for University and Science Education is in keeping with this important objective. However, the National Energy Strategy proposes that as many as 100 new nuclear electric powerplants will be built in the next 20 to 40 years. The average age of the teaching staff for nuclear technologies is about 10 years older than the national average of faculty for other engineering disciplines. This is largely due to the lack of new faculty entering these fields. In addition, we will also lose expertise in the private sector nuclear industry as older personnel retire and fewer new graduates enter these fields. The majority of graduate students in nuclear technologies are foreign students and often are not eligible for U.S. government jobs in sensitive areas in these fields. The Subcommittee believes activities must begin now to address this issue in order to maintain our technological capabilities.

DOE's FY91 University and Science Education program requested no funds for nuclear education and only $1 million for reactor upgrades (to complete one project). Unfortunately, DOE did not seek funds for these programs in the FY92 request, claiming budget constraints. A request of $2.5 million was included in the Nuclear Energy budget to complete funding for the existing research grants and fellowships. (This would not allow any new ones.) The

Congress provided a total of $6 million for these programs in FY91 and has traditionally supported the programs.

Subcommittee Recommendations

The Subcommittee is concerned with the lack of support at DOE for these programs particularly in view of the Department's recognition of the need to build fortifying foundations. The Subcommittee believes that the programs are interdependent and that consolidation provides advantages for both programs. Therefore, the Subcommittee directs that the Nuclear Engineering Research and Education Program and the University Research Reactor Program be combined to form the Nuclear Engineering Education and University Research Reactor Program and be included as part of the University and Science Education Program.

The Subcommittee fully supports efforts to expand the other university and science education programs, but opposes the elimination of these two subprograms, namely, Nuclear Engineering Research and Education and the University Research Reactor Programs. In consolidating these programs, the Subcommittee intends that the programs be directed and managed by the Office of Energy Research as part of the University and Science Education program.

The Subcommittee recommends that funding for the combined programs be authorized at $8.5 million for fiscal year 1992 and $22 million for FY93. The overall authorization for University and Science Education (including the Nuclear Engineering and Research Reactor programs) is authorized at $57.5 million for FY 1992 and $72.9 million for FY 1993.

Table 7

University and Science Education

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
University and Science Education	$49.0	$50.9
Nuclear Engineering Education and University Research Reactors	$8.5	$22.0
Total	$57.5	$72.9

2. Nuclear Energy

a. Nuclear Energy Research and Development

Program Description

The civilian nuclear energy program includes research and development on a number of different types of nuclear reactors. While they all depend on the fissioning of heavy nuclei (such as uranium-235) to produce energy, they differ in the coolant used, the control and moderation of neutrons, and in the type of fuel used in the reactor. Among the coolants used are water (called "light water"), helium gas, and liquid metal, such as sodium. Reactor types are generally named for the coolant used.

The budget history of the Nuclear Energy Research and Development program is in

Table 8.

Table 8

Nuclear Energy Research and Development

Funding History
($ in Millions)

Fiscal Year	Appropriations
1978	$573
1979	$859
1980	$848
1981	$789
1982	$812
1983	$704
1984	$630
1985	$414
1986	$374
1987	$327
1988	$346
1989	$353
1990	$342
1991	$306

Nuclear electric power plays a key role in supplying electrical energy for America. Today commercial nuclear powerplants generate about 20 percent of the United States' electricity supply. All of the operating commercial nuclear reactors are of the light water type, either Pressurized Water Reactors (PWR) or Boiling Water Reactors (BWR).

From an environmental viewpoint, a major benefit of nuclear electric power generation plants is that they emit no greenhouse gases and, hence, are not a contributing factor to the growing concern over the issue and implications of global warming.

The DOE Nuclear Energy program is composed of six major program budget areas (Table 9).

For the nuclear energy program, the Administration's request for FY 1992 reflects a substantial increase relative to FY 1991. However, a significant portion of this proposed increase is for two space related programs (in which DOE, National Aeronautics and Space Administration (NASA), and the Department of Defense (DOD) are involved), namely, Space Reactor Power Systems and the Space Exploration Initiative (SEI).

Table 9

Nuclear Energy
($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
Light Water Reactors	$38.5	$62.5
Advanced Reactors, Research and Development	57.0	49.5

Space Reactor Power Systems	33.5	56.0
Advanced Radioisotope Power Systems (Space)	75.5	56.0
Space Exploration Initiatives, SEI	0.0	30.0
Facilities (Operating, Equipment, and Construction)	92.5	127.8
Program Direction	8.8	16.1
Total, Nuclear Energy	$305.8	$398.0

Light Water Reactors Program

Utilities have focused primarily on light water reactors (LWRs) as the likely technology for a new generation of nuclear powerplants; this builds on the extensive U.S., and worldwide operating experience with LWRs. The principle ongoing activity for light water reactor development is the certification of standard designs, pursuant to new regulations of the U.S. Nuclear Regulatory Commission (NRC). A certified design would allow U.S. utilities to build such plants under more streamlined regulatory review procedures. An appropriate analogy is in the civilian aircraft industry, wherein a new passenger plane design is first certified and then airlines can place orders and use the aircraft with confidence.

There are four ongoing certification programs supported by the DOE; all are cost-shared with the reactor manufacturer and the DOE, each contributing half of the costs. Table 10 below shows the reactor manufacturer, the reactor type, and size, the start and completion dates and the funding limit for DOE participation.

Table 10

Light Water Reactor Certification

($ in Millions)

Reactor Type	Size in in Megawatts	Reactor Manufacturer	Year Started	Estimated Year Completed	Total DOE Funding
PWR*	1300	ABB/Combustion Eng.	1987	1993	$23.6
ABWR	1300	GE	1986	1992	$13.5
SBWR	600	GE	1990	1995	$50.0
PWR**	600	Westinghouse	1990	1995	$50.0

PWR* - Pressurized Water Reactor, System 80+
ABWR - Advanced Boiling Water Reactor
SBWR - Simplified Boiling Water Reactor (Passive Design)
PWR** - Pressured Water Reactor, AP/600 - Advanced Passive

DOE funding for the certification project is limited to $50 million for any one design; however, in addition to DOE funding support, private sector funding will be approximately $70 million for each passive reactor design (SBWR and PWR).

First-Of-A-Kind Engineering

As a follow-on to the certification program, the DOE is recommending First-Of-A-Kind Engineering activities for the certified designs.

First-Of-A-Kind Engineering is defined as the non-recurring engineering effort to produce the detailed design information for a particular standard design, beyond the level-of-detail that is required for design certification by the Nuclear Regulatory Commission

(NRC). In response to this request, in the FY 1992 budget submission to the Congress, DOE proposes to initiate a First-Of-A-Kind program to perform more detailed engineering of plant systems, key components, structural modules, and systems beyond that needed for certification. The goal is to achieve commercial standardization of the entire plant; this would include the nuclear steam supply system and the balance of plant. The balance of plant has been the root cause of approximately half of all unplanned or shutdown outages of nuclear electric powerplants.

The Subcommittee recognizes, as with any technology, the product must first be built, operated, tested, and evaluated before it can be ready for market. The research, design and development of these reactors is a rigorous process involving the investment of resources on the part of the sponsors and the government. New nuclear reactors, like new aircraft, are brought into being by progressing through various stages of development from concept, through engineering design, component development, component testing, fabrication, on site construction, sub-system and system testing, evaluation, system component modification, installation of changes, and finally, government approval for commercial construction.

Advanced Reactors Research and Development

There are two major ongoing Advanced Reactor Research and Development programs underway; they are the Modular High Temperature Gas Reactor and the Advanced Liquid Metal Reactor which includes the Integral Fast Reactor.

Program Description

The DOE requested funding for two advanced nuclear reactor programs for FY 1992. The Subcommittee has supported both of these programs in the past, beginning on November 16, 1983, with the Modular High Temperature Gas Reactor. This initiative was based on the opportunity to build a safer reactor system and was made because of public concerns over the safety of existing nuclear powerplants. The "Modular High Temperature Gas Reactor" and the "Advanced Liquid Metal Reactor," each have the potential to provide an energy source which will shut down safely and without operator intervention under all conceivable accident conditions without the release of radioactive materials to the environment.

Modular High Temperature Gas Cooled Reactor (MHTGR)

The mid-term technology focus of the Advanced Reactor Program is the Modular High Temperature Gas Reactor (MHTGR). The MHTGR is designed to provide a high level of passive safety and to operate with helium coolant. This design has considerable commonality with one of the designs being considered for the New Production Reactor (NPR). The NPR is funded by DOE/Defense Programs.

The MHTGR possesses two unique features. First, it uses ceramic fuel particles with high-temperature heat resistant (up to 4350° F) coatings as a multiple and diverse barrier to the release of fission products. Second, it is the only reactor design which offers the potential for cogeneration applications for industrial process heat as well as commercial electric power producers.

The MHTGR design effort is being carried out by several participants. The proposed module size is for approximately 150 megawatts of electricity. Since 1978, nearly $416 million has been invested in the MHTGR through 1991.

In FY 1992 the MHTGR program plans to demonstrate fuel quality and performance, and to simulate heat removal from the core and pressure vessel. Specific activities will include fuel irradiation testing and the initiation of post-accident simulation testing of irradiated fuel, and an assessment of the direct cycle gas-turbine and applications of process heat. Cooperative international research and development efforts will continue with France, Germany, Japan, and the United Kingdom.

The MHTGR program has progressed from the conceptual stage and is a candidate for a new production reactor to be built for defense purposes. The DOE has carefully integrated civilian with new production MHTGR design and development to achieve maximum cost effectiveness by common activities."

The DOE has not yet made its decision as to whether it should build a "heavy water" reactor or the MHTGR for production purposes. The Subcommittee recognizes the potential for capitalizing on this arrangement since the work done on the NPR would materially contribute to the development of the MHTGR for civilian purposes.

Until the decision is made on the NPR however, the future of the MHTGR program is unclear. Therefore, the Subcommittee directs the DOE to outline its plans for the continuation of MHTGR development in the event the DOE selects a heavy water reactor for the NPR. The DOE is therefore to submit a comprehensive civilian MHTGR Program Plan to the Subcommittee 90 days after enactment of this bill. This plan is to define the schedule, resources and complete cost estimates for a development program based on two alternatives; one including the NPR and the second the demonstration of a 425MW MHTGR plant at a location where the plant could stay in operation and be used for commercial purposes.

Advanced Liquid Metal Reactor (ALMR), and the Integral Fast Reactor (IFR)

The longer-term research and development project for the Advanced Reactors Program is focused on the Advanced Liquid Metal Reactor (ALMR) and the Integral Fast Reactor (IFR). The ALMR has the potential to address the waste issue through the separation and recycle of waste products back into the reactor. This process could reduce much of the resulting waste to short-lived isotopes. The ALMR concept utilizes natural circulation. Reactor tests conducted on EBR-II have demonstrated shutdown safety. Because the sodium will not boil, there is also less pressure and stress on the reactor vessel and the primary cooling system than would occur with water coolants.

The IFR development covers the reactor system as well as its complete fuel cycle ranging from fuel fabrication to reprocessing and waste management. The safety of the IFR system was demonstrated in a series of safety tests at the EBR-II facility. More recently, emphasis shifted to the demonstration of the performance of the new IFR fuel; the fuel performance, including long lifetime, has been demonstrated and the EBR-II test reactor is now completely furnished with the new IFR fuel.

Currently, the IFR program focus is on the demonstration of the innovative processing technology for spent fuel. The next major milestone is the completion of the refurbishment of the EBR-II Fuel Cycle Facility. When this is completed in late 1991, EBR-II and its Fuel Cycle Facility will start operating as a small scale pilot-plant. This demonstration, expected to be completed by the end of 1995, will include near-commercial-scale IFR fuel cycle processes and actinide recycle technology. The ALMR has the potential to address the waste issue through the separation and recycle of waste products back into the reactor. The waste recycle and burn-up efforts are in the experimental stages.

The on-site provision of fuel fabrication and waste treatment systems are attractive features for assuring safe operations. While the waste treatment subsystem needs more research and development, there is cause to be optimistic about future progress in solving nuclear waste problems if such work is a cooperative effort including the national laboratories and U.S.-owned reactor manufacturers.

The ALMR development work has proceeded well and has been accelerated through the use of an existing reactor and other facilities at the Idaho National Engineering Laboratory (INEL). One of the difficulties in creating new technologies today, in government and industry alike, is in financing components and equipment needed to demonstrate the capabilities of a complete system. In this respect, the work at Argonne East and Idaho National Engineering Laboratory (INEL) has been performed on a very cost effective basis.

Space Reactor Power Systems

Besides nuclear energy technologies for civilian electric power use, the DOE Nuclear Energy Research and Development program also supports the application of nuclear power technologies to meet a variety of space and defense power requirements. The DOE pursues these efforts as part of its charter under the Atomic Energy Act.

This program embraces two main activities: the tri-agency (DOE, NASA, DOD) SP-100 space reactor power system that is the principal thrust of the Nation's space reactor efforts and the backup effort on thermionic reactor systems technology. Both programs are supported and jointly funded by DOE with NASA and/or DOD. DOE's FY 1992 funding request of $56.0 million, represents an increase of $22.7 million over its FY 1991 appropriation or nearly a 70 percent increase. This level of funding provides for DOE participation in the SP-100 program as was proposed in the amended Memorandum of Agreement signed in late 1989 with NASA and DOD.

The SP-100 reactor system aims to develop, demonstrate, and make available space nuclear reactor technology capable of generating hundreds of kilowatts, thus meeting the power requirements of a variety of civilian and military applications during the early 2000s and beyond. The program is in its sixth year of designing and engineering a ground test reactor and conducting tests of nuclear fuel, materials, and components.

Advanced Radioisotope Power Systems

The purpose of the Advanced Radioisotope Power Systems program is to produce radioisotope power systems for U.S. civilian and military terrestrial and space missions. Radioisotope power systems, in use for almost three decades, are proven, reliable, and maintenance-free power supplies capable of producing up to one kilowatt electric (KWe) for tens of years.

The Advanced Radioisotope Power System program provides base support for radioisotope fuel and heat source development, production, and qualification; nuclear safety analysis and testing; power converter system development; and all aspects of manufacturing, quality assurance, reliability, and operational safety for radioisotope power systems.

Development efforts on the Thermionic Fuel Element (TFE) will continue in FY 1992. The TFE program includes insulator, fueled emitter, collector, and thermionic converter tests in irradiation facilities. It will continue component testing initiated in recent years and is expected to culminate with a prototypic test of a six-cell TFE in a fast reactor environment in FY 1995.

The DOE has reduced its funding request from $75.1 million in FY 1991 to $56.0 million in FY 1992. This reduction reflects the fact that efforts to restore production facilities started in FY 1990 and FY 1991 are nearing completion and that the construction of the Radioisotope Power System Facility is being deferred.

Radioisotope Thermoelectric Generators (RTG)

DOE programs in FY 1992 will continue to develop systems using RTGs and to provide improved RTG power systems and related technologies for future missions. These efforts are directed to improve heat source and converter performance and safety, to improve production efficiencies and reduce costs, and to pursue long-term technology development, especially in the thermoelectric materials area.

The facilities to process Pu-238 were placed on standby in the early 1980s and are in the process of being reactivated. Resumption of reactor operations, including Np-237 target irradiations, and the Pu-238 processing facilities will provide Pu-238 for the Comet Rendezvous Asteroid Flyby (CRAF) and Cassini missions by early FY 1993.

The emphasis in near-term efforts supports the CRAF and Cassini missions directed by NASA. To learn from the experience acquired from earlier RTGs, an FY 1991 effort will dismantle and analyze the qualification RTG for the Galileo and Ulysses missions after successful long-term life testing of over 53,000 hours. The backup Ulysses flight RTG has also been returned to monitored storage until it is needed for the CRAF mission.

Space Exploration Initiative (SEI)

The DOE is requesting $30 million in FY 1992 to initiate a cooperative, cofunded program with NASA to support the Space Exploration Initiative (SEI). This program is within the scope of the broad Memorandum of Understanding between DOE and NASA that was signed in FY 1990, but did not specify particular programs or funding levels. This new program proposes to develop nuclear propulsion and power systems and nonnuclear technologies for the manned exploration of the moon and Mars.

Efforts on nuclear propulsion are being initiated as one of the critical technologies for SEI because of its relative advantages over chemical propulsion. These advantages include the potential for shorter trip times, thereby reducing radiation exposure to the astronauts, and for smaller system mass resulting in lower launch costs. In its first year, this program proposes to evaluate nuclear propulsion concepts and associated technologies and will initiate development of key long term efforts. The program will also evaluate the facilities that will be needed for fuel fabrication, irradiation testing, and integrated propulsion engine testing.

Facilities

The operation of facilities provides for the safe and reliable experimental and test capabilities needed to develop civilian fission and fusion nuclear power technologies and systems, to support space and defense missions requiring nuclear power, and to support other programs. The DOE is requesting $127.8 million for support of the nuclear energy facilities for which it is responsible in FY 1992.

DOE is strengthening its management efforts to ensure the safe, environmentally acceptable, and reliable operation of its facilities. These efforts are intended to build on improvements in management and operations already made in response to the reviews by the National Academy of Sciences, and DOE's Advisory Subcommittee for Nuclear Facility Safety; the DOE intends to fully implement applicable Institute of Nuclear Power Operations (INPO) good practices.

In FY 1992, the facilities program plans to emphasize the following activities: the initiation of the IFR fuel cycle demonstration with metal fuel recovery and fabrication in the Fuel Cycle Facility, the conclusion of Tower Shielding Facility operations in support of the joint DOE/PNC (Power Nuclear Corporation/Japan) shielding program, and the performance of surveillance and maintenance.

There are two operating DOE Liquid Metal Reactors (LMR's) for research and testing of fuels and materials under fast neutron bombardment as opposed to slow neutrons in a light water reactor. The EBR-II at Idaho Falls, has been operating for 25 years. The Fast Flux Test Facility (FFTF) at Hanford has been running for nine years. The operation of the FFTF during FY 1991 is funded by the separate DOE account under Environmental Restoration and Waste Management.

Out of the concern for cost effectiveness, DOE conducted a comprehensive evaluation of long-term missions of the FFTF at Hanford, Washington. It determined that the amount of work done there, predominantly work done under the Advanced Reactors program, does not justify the expense of its continued operation and that essential testing done in the FFTF could be done in the EBR-II. Congress, in FY91, authorized continued operation of FFTF and directed the DOE to support an initiative by the Governor of the State of Washington to seek alternatives to sole government funding for the facility.

The State of Washington has enlisted the help of Westinghouse, the designer, builder and operator of FFTF under a contract with the DOE, to seek interest in an international program of research using the FFTF as a research center. These efforts are in the early stages of development; the prospects for success will not be known until March 31, 1992. The DOE FY92 budget request provides only for the shutdown of FFTF since results are not yet available from the Governor's initiative.

The major sites and the major facilities funded by the DOE FY 1992 budget request are summarized in Table 11.

Table 11

Major Facilities

Argonne National Laboratory-West (ANL-W), near Idaho Falls, Idaho

EBR-II	Experimental Breeder Reactor-II
FCF	Fuel Cycle Facility
FMF	Fuel Manufacturing Facility
HFEF	Hot Fuel Examination Facility
TREAT	Transient Reactor Test Facility
ZPPR	Zero Power Physics Reactor

Westinghouse Hanford Company (WHC), near Richland, Washington

FFTF	Fast Flux Test Facility
FMEF	Fuels and Materials Examination Facility

Energy Technology Engineering Center (ETEC), near Canoga Park, California

Subcommittee Recommendations

The Subcommittee authorizes the funding for Nuclear Energy Research and Development for FY 1992 and FY 1993 as provided in Table 12.

Table 12

Nuclear Energy

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
Light Water Reactor (LWR)	44.5	62.5
Advanced Reactors Research and Development	60.5	73.0
Space Reactor Power Systems	36.0	36.5
Space Advanced Radioisotope Power Systems	56.0	58.0
Space Exploration Initiative (SEI)	5.0	5.0
Facilities (Oper., Equip. & Const)	178.8	168.8
Program Direction	10.2	16.2
Total	391.0	420.0

Light Water Reactors

The Subcommittee received testimony on the Light Water Reactor (LWR) program on March 6, 1991. At that time, the DOE stated that during fiscal year 1992, DOE and industry will continue with two cooperative cost-shared programs, to develop and certify advanced light water reactor designs. One program supports certification of two evolutionary standardized designs, while the second supports two advanced passive standardized designs. The objective is to have all four designs certified by 1995.

The Subcommittee agrees that the certification of standard reactor designs is a positive step toward revitalizing the nuclear power option and recommends continuation of support and completion of the System 80+, Advanced Boiling Water Reactor (ABWR), Advanced Pressurized Passive-600 Megawatt-electric (AP-600) and Simplified Boiling Water Reactor (SBWR) programs. The Subcommittee also believes that balance of plant considerations are an important part of this certification effort. Recent information indicates that more than half of all plant shutdown events are attributable to system elements beyond the nuclear steam system. If public confidence in nuclear power is to be restored, then the public must be assured that all design certification efforts address that portion of the plant most susceptible as an initiator of difficulties, namely, the balance of plant.

Furthermore, the Subcommittee does not support embarking on a new program for First-Of-A-Kind Engineering to develop a number of plant designs. The Subcommittee recognizes that it cannot properly support First-Of-A-Kind Engineering for four different reactor designs in the current or foreseeable budget climate. The Subcommittee believes the most important role that this program can play is to provide an incentive for taking the step of putting the first new reactor order on the books.

Therefore, the Subcommittee authorizes $2.0 million in FY 1992 for the specific purpose of initiating engineering design in support of the construction of a new nuclear powerplant. The design shall be in addition to that needed for certification and shall be based on one of the design concepts currently included in the certification program in accordance with the following provisions.

The DOE is to prepare and issue a Request for Proposals for Final Design Engineering, including site adaptation to U.S. owned reactor manufacturers, or those who will conduct the majority (75 percent) of their reactor design, manufacturing and construction activities in the U.S., who could respond as individual firms or in joint venture with other U.S. owned firms, in accordance with the following provisions:

1. The Offeror would have to provide a signed and notarized agreement from a licensed utility company, or other legitimate power producing organization, indicating the financing and resources to be committed by the utility over a specified period of time for the construction in the United States of one of the certified designs.

2. The reactor manufacturer would have to submit complete design and construction management plans including warranties for plant performance, power output and the useful life of major components and indicate how he would design and construct one of the NRC certified designs.

3. The reactor manufacturer would also have to submit signed and notarized warranties covering complete responsibility for the design, construction, and first year of plant operation. This responsibility must include the entire plant, including the balance of plant, and all facilities and equipment related thereto.

The offer is to be good for one and only one such undertaking and is not to be repeated. In order to qualify as the reactor manufacturer, the Offeror has to be the first firm to submit an acceptable proposal, complete with a utility agreement, to the DOE. Upon the receipt and acceptance of an offer from a U.S. reactor manufacturer and a utility company, no further similar authorizations will be made. The Subcommittee does not intend to authorize any other support for First-Of-A-Kind Engineering.

It is to be understood: this offer is for first of a kind design for the express purpose of building a new nuclear powerplant. Should for any reason, due to the fault of the Offeror or his successor(s), the project be terminated or stopped for a period exceeding 18 months before the completion of construction, the Offeror or his successor(s) shall be liable to repay the government for the total amount of the government funds invested up to that time.

The Request for Proposals is to provide for an extended period of time in which to respond. Given the prevailing constraints in building new nuclear plants, the proposal period could be open for well over a year. In consideration of an acceptable offer, the Federal Government would provide matching funds up to a limit of $20 million each year, for a total of $60 million, over three years to assist in the design, construction and initial equipment procurement for a full scale previously certified civilian nuclear reactor.

Subcommittee Recommendations

Advanced Reactors Research and Development

In spite of the achievements and promise of safer nuclear power, the Subcommittee would like to see more rapid progress on the advanced reactor programs. While the Subcommittee recognizes funding limitations, the Subcommittee also notes funds budgeted by the DOE for other programs where the potential benefits to the American public are much less clear.

On the MHTGR, the Subcommittee views that the budget allocation implicit in the Administration's FY92 request to the Congress for the advanced reactors is inadequate - especially if that design concept is not selected by DOE in December 1991 as the technology for the New Production Reactor (NPR).

The Subcommittee authorization provides $60.5 million for FY 1992 and $73 million for FY 1993 for the Advanced Reactors Research and Development program. Of this total the Subcommittee recommends $41 million for FY 1992 for the ALMR development and $16.5 million for the MHTGR development. Of the total funds provided for the Advanced Reactors

Research and Development programs, no less than $25 million is authorized for the Integral Fast Reactor development work and no less than $4 million is authorized for the actinide recycle program. The Subcommittee supports current participants on the University Research program in Robotics funded through the Advanced Reactors program at a level of $3.5 million in FY 1992 and $3.5 million in FY 1993. Given the likelihood that radiation exposure limits for workers may be further reduced in the future, the Subcommittee believes the Robotics program is a prudent investment in technology development and compatible with the overall Advanced Reactors program goals. In that same trend, the Subcommittee continues to support DOE's on-going Advanced Controls research, and in particular, support the advanced controls program (ACTO) at the level of $2.5 million for FY 1992 and FY 1993 as described in DOE's budget request. Finally, as was discussed in the University and Science Education section of this report, the Subcommittee has directed the DOE to fund Nuclear Engineering Education and the University Research Reactors program under the University and Science Education program.

Space Reactor Power Systems

The Subcommittee recommends $36 million in the DOE FY92 budget for the nuclear reactor space power program. The focus now is on component development and qualification. It is the Subcommittee's recommendation that at this stage NASA and DOD should pick up more of the funding instead of DOE. The Subcommittee views that the Space Reactor Power System, particularly the SP-100, is in need of further definition in context of specific mission needs. The Subcommittee recommends that DOE reevaluate deferring activities related to the Radioisotope Power Systems Facility (RPSF). To defer activities at this time will leave DOE with another unfinished project. Restart after deferral will significantly increase the overall project cost and schedule. To maintain RPSF in a safe and environmentally sound condition such that it can best be utilized for future NASA and DOD missions requires DOE to complete the project. Completing RPSF will provide DOE with a completed RTG assembly facility that meets all current criteria.

Space Exploration Initiative (SEI)

The Subcommittee authorizes $5 million for SEI for Fiscal Year 1992. This amount is sufficient in this very early, generic phase in support of possible use of nuclear technologies in future missions of exploration to the Moon and Mars. The Subcommittee is concerned that Department of Energy and NASA witnesses did not provide sufficient information to properly evaluate the Fiscal Year 1992 budget request and the merits of the SEI program. In light of this concern, the Subcommittee directs DOE to prepare a detailed plan, in consultation with the user agencies, outlining its scope, objectives, requirements, estimated cost, and schedule for thils program. The report shall be submitted to the Subcommittee by December 31, 1991.

Facilities

The Subcommittee authorizes $178.8 million for facilities in the DOE's budget request for FY 1992 and $168.8 million for FY 1993. Within the $178.8 million for FY 1992, $79 million is authorized for the Fast Flux Test Facility (FFTF). The Subcommittee strongly supports continued operation of the FFTF during FY 1992 to allow sufficient time for the State of Washington to fully explore possibilities for more international participation, including funding from countries such as Japan. Following this one year extension, the FFTF Facility should be re-evaluated to determine if it is realistic to continue, such as with cost-sharing with non-governmental portions. If a cost-sharing agreement is reached for continued operation of the FFTF by March 31, 1992, the Subcommittee authorizes not more than $69 million for FY93.

In support of the mission of the State of Washington, in regard to the Fast Flux Test

Facility (FFTF), the Subcommittee fully supports the establishment of the FFTF as a multi-mission research and development center (Research Reactor User Complex (RRC)), which will be operated by the DOE in partnership with international and domestic user organizations.

The Subcommittee supports authorizing agreements between DOE and non-Federal entities (which includes foreign governments, and other entities) or a consortium of such entities to use the FFTF RRC for: (1) the production of industrial and medical isotopes; (2) irradiation services which support research and commercialization objectives; and (3) production of steam.

The establishment of the FFTF RRC by DOE should take place within 90 days of enactment. Agreements between DOE and non-federal entities, including foreign governments and entities, is authorized. DOE is also provided with authority to assess necessary or appropriate charges from the non-Federal entities and to make agreements with the non-Federal entities for no more than 25 years.

There is authorized termination provisions in the agreements which DOE makes with non-Federal entities, which require DOE to pay for the unamortized balance of any depreciable structures, equipment, materials, or services built, acquired, or provided by the non-Federal entities. However, the termination provisions will only apply if the RRC is shut down for lack of Federal appropriations and, the depreciable property or materials represent a significant portion of the non-Federal entities overall investment under the agreement.

The DOE is also authorized, as part of any agreement, to: (1) provide any necessary services; (2) lease property; (3) offer appropriate indemnification pursuant to the Price-Anderson Act; and (4) include any appropriate terms and conditions.

The Secretary of Energy is permitted to use competitive procurement procedures other than those described in the Federal Property and Administrative Services Act.

It is required that the DOE contractor operating the RRC maintain and operate the facility pursuant to the Atomic Energy Act, ensure that all experiments meet applicable safety requirements, and provide necessary support services to the non-Federal entities.

There is also established the RRC Fund which will consist of all revenues received from the charges assessed to non-Federal entities. DOE is authorized to use the funds in the RRC Fund to offset the operating costs of the RRC and any remaining sums must be invested in U.S. securities with interest accruing to the fund.

Program Direction

The Subcommittee authorizes $10.2 million for FY 1992 and $16.2 million for FY 1993.

b. Civilian Radioactive Waste Research and Development

Program Description

The Office of Civilian Radioactive Waste Management (OCRWM) was created to carry out the missions of the Nuclear Waste Policy Act (NWPA) of 1982, P.L. 97-425, as amended. The DOE is responsible for implementing the NWPA and has encountered strong opposition in developing a permanent geologic repository. The research and development directives in the law are now being performed by DOE Defense Programs and the OCRWM is not conducting any research or development activities relating to high-level radioactive waste issues or technologies. The federal government, under the NWPA, is required to take title to the spent fuel of our nation's reactors by 1998. The latest estimate from DOE is that a repository will not be ready until at least 2010.

Currently, each commercial reactor stores its spent fuel on-site at the reactor. There are 111 licensed reactors in the U.S., and a few have terminated operations, but spent fuel remains at those sites. Some of the older reactors are approaching their full capacity for storing spent fuel in their pools. Large pools of water are used to dissipate the thermal heat of spent fuel, and water also serves as a shield to protect against radiation exposure.

The Civilian Radioactive Waste Research and Development, a subprogram under Nuclear Energy, has participated in an industry cost-shared project to study consolidation and dry cask storage which has proven successful. The FY91 appropriation and the FY92 request, $696,000 and $700,000, respectively, clearly show that this is the only research and development activity currently pursued by the DOE in civilian nuclear waste research and development.

Table 13

Civilian Radioactive Waste Research and Development

Funding History
($ in Millions)

FY84	$2.75
FY85	$25.89
FY86	$15.99
FY87	$6.49
FY88	$5.0
FY89	$2.5
FY90	$.98
FY91	$.70

Table 14

Civilian Radioactive Waste Research and Development

	FY 1991 Appropriations	FY 1992 Request
Civilian Radioactive Waste Research and Development	$696,000	$700,000

Subcommittee Views

The Subcommittee commends the DOE for its efforts in supporting the utility industry in order to safely manage on-site nuclear waste storage.

While a geologic repository seems to be the solution today for long term storage/disposal of high-level waste, the Subcommittee believes there are ample opportunities to perform research and development to assist in resolving some of the problems from a different perspective. Research and development could be valuable in reducing the half-life of the highly radioactive material through transmutation, or research and development of new technologies could lead to new methods of reducing the volume. In voicing this opinion, the

Subcommittee likewise rejects the view held by some that progress in developing new technologies to mitigate the problems surrounding nuclear waste will be used as a rationale to further delay the completion of the repository.

The Subcommittee is disappointed in the DOE's failure to support technology advancements in the mitigation of nuclear waste. While the research and development in actinide burning currently underway at INEL through the Integral Fast Reactor Program is encouraging, a much stronger program is needed for a complete solution to the nuclear waste problem.

The nuclear waste problem is seen as a challenge to America's science and engineering communities, including those in laboratories, industries, and universities. The problem is not only difficult, but it requires that a multitude of resources be brought to bear on a common objective; providing for the safe management, storage and disposal of nuclear waste within time periods acceptable to the public.

The Subcommittee is familiar with the primary thrust of the U.S. program directed toward repositories. While the solidification of high-level waste coupled with repository disposal offers many advantages, future waste mitigation alternatives may prove to be more complete and provide for shorter periods from after reactor radiation levels to background radiation levels. To this end, the Subcommittee is pleased with the work at the national laboratories and certain private sector companies.

The Subcommittee is not pleased with the inability of the nuclear community to work in consort on a unified national nuclear waste mitigation effort. The Subcommittee is also disappointed with DOE's lack of commitment and inability to lead such an effort as evidenced by the lack of emphasis reflected in the FY92 budget. The Subcommittee believes that nuclear waste issues must be effectively addressed if nuclear power is to play a more prominent role in meeting our future energy needs.

There appears to be at least three potential efforts that may well be supported individually, as well as from the point of possible synergistic interaction.

(1) An accelerator to transmute nuclear waste into products with shorter half-lives and which could thereby significantly reduce nuclear waste storage periods. There is also the potential for a thorium fueled gas reactor in the future which could mitigate its own nuclear waste while producing electricity.

(2) The continuation of actinide burning development offers much potential. Considerable effort has gone into this work, and the results to date have been encouraging.

(3) Finally, the last effort is one of basic research and support for the aforementioned efforts. Hopefully, the resources of our universities could be enlisted to work on this national problem.

Table 15

Civilian Radioactive Waste Research and Development

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993

Civilian Radioactive Waste Research and Development	8.0	8.32

The Subcommittee authorizes $8 million in FY 1992 and $8.32 million in FY 1993 to increase the resources dedicated to nuclear waste mitigation. This additional funding is also to enable DOE to organize and staff a program office for the purpose of bringing together the national laboratories, universities and private sector organizations who can contribute to advancements in solving the nuclear waste problem in a cohesive and integrated program. Specifically, the program shall include the Argonne National Laboratory, the Pacific Northwest Laboratory, the Lawrence Livermore National Laboratory, the Los Alamos National Laboratory, and private firms having experience in nuclear reactor waste mitigation.

Therefore, DOE is to review past accomplishments, identify the technical needs for continuation of existing programs or the initiation of new efforts, structure a plan for implementing the necessary action and report to the Congress within 90 days after enactment, on its findings, objectives, management, estimated cost, and schedule for pursuing waste mitigation research and development.

The Subcommittee intends to continue with this program in FY93. The DOE will provide for future budget requests, a program plan with milestone objectives which clearly establish progressive goals, schedules, and estimated costs. After FY93, the Subcommittee will reassess the progress made in order to determine the extent of continuing effort. It is the Subcommittee's intention to have DOE structure a small program staffed with the most capable personnel knowledgeable in the disciplines appropriate to solving the waste problem and who can work together effectively across organizational boundaries.

3. Fusion Energy

Program Description

The civilian fusion energy program includes research and development on two fundamentally different approaches: magnetic and inertial confinement systems. Both rely on the principle of conversion of mass to energy when two light nuclei, such as hydrogen and deuterium, or deuterium and tritium come together and fuse at very high temperatures. For magnetic fusion this reaction would occur in the regime of 100 million degrees. Fusion is the opposite of fission, in which a heavy isotope, such as uranium 235, is split apart by an incoming neutron thereby releasing kinetic energy. The harnessing of fusion will have not only enormous energy benefits but also will be relatively benign environmentally.

Table 16

Fusion Energy

Funding
($ in Millions)

Program	FY91 Approp.	FY92 DOE Request
Base	175.6	167.2
TFTR	60.6	75.3
ITER/EDA	17.1	41.8
BPX	16.7	30.8
IFE	1.6	8.2
Capital Equip./	10.4	9.2

Construction	7.6	4.6
Total	289.6	337.1

Magnetic Fusion Energy

As a result of concentrated efforts throughout the industrialized world, a broad consensus now exists on how ignition can occur through magnetic confinement. Significant progress has been made toward this goal. To date, the most effective way to achieve magnetic confinement is in a toroidal, or doughnut-shaped device. The leading toroidal confinement concept is the Tokamak. In terms of fusion power production, the Tokamak has improved by more than a factor of a million over the past 15 years. Recent results indicate that the Tokamak Fusion Test Reactor (TFTR) at Princeton is close to break-even conditions, wherein the energy produced using the appropriate fuel would equal the energy applied to initially heat the fuel.

Inertial Fusion Energy (IFE)

The IFE technology differs fundamentally from magnetic fusion. Inertial fusion for energy applications will proceed by compressing a small deuterium-tritium fuel capsule to high density using pressure from uniform irradiation by short-wavelength light or ion beams as drivers. According to validated physics models, the compression will heat the central core of the capsule in which rapid nuclear fusion reactions ignite the deuterium-tritium fuel. The heat from reaction-produced alpha particles will propagate through the surrounding high density fuel resulting in burning of most of the fuel and release of energetic neutrons. Net energy gain, defined as the ratio of fusion energy released to input driver energy, should be possible with a ratio up to about 100.

Objectives

The goals of the redirected fusion program are to achieve a demonstration plant by the year 2025 followed by a commercial powerplant by 2040. The strategy is to support two separate and distinct approaches to fusion energy development: magnetic fusion energy and inertial fusion energy. The pursuit of both options will reduce the technological risk associated with the difficult task of developing fusion energy. The strategy in each case is to gain scientific understanding of the complex processes involved in ignited and burning plasmas and to use this understanding to develop fusion technology in an engineering test facility. The final step toward commercialization would be the construction of a demonstration powerplant. The overall program must ultimately include the study and development of the most effective confinement systems, materials, and technology to ensure the eventual economic success of fusion. An important element in carrying out this strategy is to take full advantage of international collaboration while maintaining a sound domestic program.

Funding History

The nation's magnetic fusion energy (MFE) research program began in 1951 under the auspices of the former United States Atomic Energy Commission. Since 1972, the U.S. has spent over $8 billion, in constant 1990 dollars, on research into MFE. Table 17 shows the budget history since 1972 in constant 1990 dollars. In FY 1991, $273 million was appropriated for the MFE program. In January 1991, the Secretary of Energy asked the Congress for authority to reprogram $25 million from other parts of DOE to MFE (which was approved).

For FY 1992, DOE has requested $337.1 million for the magnetic fusion energy program. This funding is less than that recommended by the report (issued in September 1990) of the Fusion Policy Advisory Subcommittee (FPAC). However, the redirected program, making a transition from a research oriented effort to an energy program, follows the FPAC recommendations and is also reflected in the President's National Energy Strategy.

Table 17

Magnetic Fusion Energy

Funding History
(Millions of Constant 1990 Dollars)

Year	Millions
1972	105
1973	120
1974	160
1975	300
1976	380
1977	675
1978	670
1979	660
1980	585
1981	605
1982	610
1983	580
1984	575
1985	510
1986	410
1987	380
1988	360
1989	365
1990	317
1991	298

The mainline U.S. magnetic fusion energy program now consists of three principal activities:

TFTR - Tokamak Fusion Test Reactor, located at the Princeton Plasma Physics Laboratory

BPX - Burning Plasma Experiment, proposed machine to achieve ignition by the year 2005. This machine is expected to cost $1 billion, and is now in the preliminary design phase.

ITER - International Thermonuclear Experimental Reactor

The most successful experimental magnetic fusion device thus far developed is known as a Tokamak. In the Tokamak, the plasma is contained in a toroidal (donut-shaped) chamber surrounded by magnetic field coils. Currently, the largest and most successful Tokamaks are the Tokamak Fusion Test Reactor (TFTR) at the Princeton Plasma Physics Laboratory (PPPL) in New Jersey and the Joint European Torus (JET) in England. The latter is a project being sponsored by the European Community. Both the TFTR and JET have succeeded in reaching a combination of density, temperature and confinement time of about 70 percent of that needed for energy break-even. The goal after breakeven is ignition. At ignition the energy generated by the fusion reaction is sufficient to cause other light nuclei to collide thereby sustaining the reacting system.

At this time it is expected that energy breakeven will be achieved in both the TFTR and

JET in the next two or three years. To do so will require using deuterium (D-D) and tritium (D-T) in the experiment because of the large energy gain achieved from the D-T reaction compared to the D-D reaction. If the two Tokamaks were using deuterium and tritium now, they would both be very close to energy break-even.

Shifting to deuterium and tritium, however, will result in production of radioactivity at levels that would force either machine to be decommissioned after about two years. The reason is that tritium is naturally radioactive and the deuterium-tritium reactions produce large quantities of neutrons. Neutrons are responsible for producing most of the radioactive materials by way of nuclear reactions with atoms in the materials making up the containment structure.

Burning Plasma Experiment

The Burning Plasma Experiment is an important part of the magnetic fusion effort. In the past 15 years there has been no new major world-class fusion facility built in the United States, that is, one that would outperform the TFTR. The BPX would accomplish that next key step.

The purpose of the Burning Plasma Experiment is to investigate the physics of self-heated fusion plasmas and to demonstrate the production of 100 - 500 MW of fusion power. In the process, the Burning Plasma Experiment will investigate the confinement physics, and operational limits, of self-heated fusion plasmas. In addition, it will demonstrate many of the heating, fueling, and plasma handling technologies necessary to produce reactor-level fusion. The Burning Plasma Experiment is intended to advance our knowledge of physics and technologies so that U.S. scientists and industries could effectively participate in the international collaborative effort to develop fusion power known as the International Thermonuclear Experimental Reactor (ITER). Current plans call for construction of the BPX to begin in FY 1993; the project is currently undergoing preliminary design and siting related activities, such as the preparation of the Environmental Impact Statement.

International Thermonuclear Experimental Reactor

The ITER provides a focus for the international collaborative effort to develop magnetic fusion power. There are four active coequal partners in the ITER project. They are: 1) the United States; 2) the European Community; 3) Japan; and 4) the Soviet Union. The U.S. has entered negotiations to participate as an equal partner in the Engineering Design Activities of ITER. San Diego, California, is a candidate site for the Engineering Design Phase of the ITER program.

Tokamak Fusion Test Reactor (TFTR)

To contribute to the success of ITER and to maintain a strong domestic program, the U.S. will carry out Deuterium-Tritium (D-T) experiments in TFTR. These experiments are expected to lead to the attainment of break-even conditions. In addition, they will provide valuable experience in conducting experiments using tritium. The first experiments using D-T fuel are planned for FY 1993.

Civilian Inertial Fusion Energy (IFE)

The Civilian Inertial Fusion Energy (IFE) effort will be limited to a one-driver concept and to budget-paced technology development. This program will rely on continuing development of target physics and ignition characteristics within Defense Programs. The heavy ion driver, successfully conceived through Defense Programs and Basic Energy Sciences activities, is planned to be extended and tested. Technology research and development will be based on reactor studies and rely on progress within the world-wide magnetic fusion program for common elements such as low-activation materials and breeding blankets.

Subcommittee Recommendations

The Subcommittee supports the policy that the program should move from a research oriented program to an energy technology development program. This is a major change in the character of the program and its objectives.

The Subcommittee is pleased that the Administration's National Energy Strategy (NES) report, recognized that the fusion effort is more than fundamental physics research but is an energy program with a mission of much potential and merits stable, long-term support. The Subcommittee also notes with satisfaction the comprehensive report of the Fusion Policy Advisory Subcommittee (FPAC) released in September 1990. The Subcommittee is of the view that the conceptual development program outlined by FPAC, with the constrained budget case, serves as a useful framework for on-going strategic planning of an integrated and coordinated fusion energy program with parallel magnetic and inertial efforts.

Taking into account the present status of the programs, the Subcommittee recommends focusing on three pivotal issues: (1) the introduction of tritium into the TFTR should proceed expeditiously so that Deuterium-Tritium experiments could be conducted in the facility by FY93; (2) the construction of the Burning Plasma Experiment (BPX) should be initiated as a line item project in FY93 with a scheduled completion, operational date during the year 2000; (3) the DOE should use all appropriate means to encourage that the next phase of ITER, the Engineering Design Activity (EDA), be sited in the United States.

The Subcommittee urges that DOE encourage more involvement of the private, industrial sector in all phases of the fusion program as it moves into the technology development phase. The DOE should require that contract proposals provide for significant industry participation,, where appropriate, using a teaming effort with a national laboratory and a university in carrying out the particular project. The Subcommittee is concerned that major funding reductions in 1990 and 1991 may have reduced the program capability to understand basic phenomenon of the confinement and transport problems. The Subcommittee requests that the DOE conduct an independent assessment of the contribution that the Advanced Toroidal Facility (ATF) can make to this understanding and that DOE maintain ATF on standby until the results of the assessment can be considered in the context of the magnetic confinement development strategy.

The Subcommittee authorizes DOE's FY92 budget request of $337.1 million for fusion energy programs be retained and notes that it is a minimal level to sustain the overall program.

For purposes of multi-year authorization planning, the Subcommittee authorizes $387 million for FY 1993; this amount includes $35.4 million for design work to initiate construction of the Burning Plasma Experiment Facility.

Table 18

Fusion Energy

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993

Base Program	$167.2	$160
TFTR	75.3	78
ITER/EDA	41.8	45
BPX	30.8	40
IFE	8.2	14
Capital Equipment/Construction	13.8	50
Total	$337.1	$387

The Base Program includes on-going activities in plasma science research and technology development for confinement systems.

4. Environmental Restoration and Waste Management Programs (Civilian)

Program Description

The DOE's Office of Environmental Restoration and Waste Management (EM) was created in 1989 to consolidate these activities and to better prioritize the environmental, worker, and public health issues. The civilian portion of this program is funded through Energy Supply Research and Development, which falls under the Subcommittee's jurisdiction.

The DOE weapons complex and related facilities have serious environmental problems with the attendant human health factors. Upon creation, the EM program set about to identify problems, create programs to minimize waste product, and re-educate management and workers regarding pollution and cleanup.

The Office is broken into four main groups: corrective activities to bring facilities into compliance with existing law; environmental restoration to assess and cleanup facilities and sites; waste management to minimize, treat, store and dispose of all types of radioactive and hazardous waste; and technology development to identify areas where cleanup technology is deficient and new approaches are required.

Prior to 1989, the DOE managed its environmental problems on a site by site basis, with no clear agency-wide plan. This led to difficulties in setting priorities, inconsistent managerial commitment, and resulted in competition among facilities for funds. In consolidating these activities under one department, DOE has gained control of the program and improved setting priorities and preparing a cohesive research and development plan.

Environmental and safety problems are endemic to a complex of facilities most of which were built 30 to 45 years ago under environmental and national security attitudes that were totally different from today. The legacy of that complex is a cleanup problem that may well cost more than $200 billion to correct. The current focus is to complete a characterization of the problem at a dozen or more sites some of which are as large as 560 square miles and contain hundreds of structures. At some sites there are structures and facilities that have been closed for 25 or 30 years. Understanding the magnitude and scope of the problem and setting priorities for cleanup and remediation have been the principle early goals of the program. A limited number of cleanup projects have been completed.

Table 19

Environmental Restoration and Waste Management

Funding History
($ in Millions)

Fiscal Year	Appropriation
FY89	$1,657.3*
FY90	$289.5
FY91	$437.0

*There is no breakdown for FY89 between Defense and Civilian Funds.

Table 20

Environmental Restoration and Waste Management

($ in Millions)

	FY 1991 Approp.	FY 1992 Request
Environmental Restoration and Waste Management	$437.0	$523.5

The Subcommittee supports the Environmental and Molecular Sciences Laboratory (EMSL), believing the thrust and scope of the EMSL will be extremely valuable in addressing several scientific challenges facing the Nation. The Subcommittee also supports the Secretary of Energy's efforts to accelerate the construction of EMSL and make equipment and instruments within EMSL available for collaborative research programs in the international scientific community.

Subcommittee Recommendation

The Subcommittee supports the DOE's request and authorizes $523.5 million for FY 1992 and $594.2 million for FY 1993 to carry out the Environmental Restoration and Waste Management program at the DOE's civilian energy facilities. The Subcommittee authorizes the Department to reimburse reasonable expenditures for the characterization and remediation of Parcel 412, Oak Ridge, Tennessee, not to exceed $600,000 during FY92 from these funds.

The Subcommittee requests a report, 6 months after enactment, of all DOE (or its predecessors) previously owned property which was contaminated by activities of the Department or its predecessors which do not meet today's environmental standards. The report should describe the contaminants, cost of cleanup, current ownership, and current use.

Table 21

Environmental Restoration and Waste Management

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993

Environmental Restoration and Waste Management	$523.5	$594.2

5. Supporting Services - Policy and Management, Energy Research

Program Description

The program provides the staffing resources and associated funding required to provide overall direction of the Office of Energy Research. In addition to directing the Office's research program, the Director of Energy Research also serves as the Department's principal science advisor for formulation of basic research policy. The FY 1992 request is $1.1 million.

Subcommittee Recommendation

The Subcommittee endorses the FY 1992 request of $1.15 million and authorizes $1.196 million for FY 1993.

B. Uranium Enrichment Research and Development

Atomic Vapor Laser Isotope Separation

Program Description

The Uranium Enrichment research and development program under the Subcommittee's sole jurisdiction is the Atomic Vapor Laser Isotope Separation (AVLIS) technology development program. The DOE's fiscal year 1992 request for this program totals $213.6 million for an increase of $59.1 million over the fiscal year 1991 appropriation of $154.5 million. Of the $213.6 million request, $204.3 million is for operating expenses, and $9.3 million is for capital equipment and construction. This compares to the breakdown of $154.5 million for fiscal year 1991 into $146.5 million for operating expenses with $8 million for capital equipment and construction.

The AVLIS research and development program goal is to develop and demonstrate a significantly less expensive method for enriching uranium. This new technology is expected to be much more economical in production and more competitive in price than the current gaseous diffusion technology which is the only process used in the United States.

The AVLIS technology uses lasers to separate vaporized uranium metal to concentrate the U-235 fissionable isotope for use as reactor fuel. The electromagnetically charged particles are collected in the separators and processed.

The AVLIS program began in 1974 and has demonstrated significant technological advancements over the life of the program. It is scheduled to complete an integrated system demonstration in FY92. The FY92 DOE requested operating budget of $204.3 million is $16.3 million over the projected request of $188 million as outlined in the January 1990 Deployment Plan. The increase is due to the closeout of the Special Isotope Separation (SIS) defense program which shared the costs for the operations of the lasers. As there is no funding for SIS in the FY92 budget, the AVLIS program must fully fund operations of the lasers.

The Deployment Plan also projected a request of $54 million for construction to perform pre-deployment, pre-construction, and design activities. The FY92 budget request includes only $3.2 million for these activities, a decrease of $50.8 million.

Atomic Vapor Laser Isotope Separation (AVLIS)

Funding History
($ in Millions)

Fiscal Year	Appropriations
FY78	$15.6
FY79	$17.2
FY80	$19.9
FY81	$31.5
FY82	$37.0
FY83	$31.2
FY84	$103.0
FY85	$78.00
FY86	$125.6
FY87	$79.1
FY88	$89.1
FY89	$125.5
FY90	$131.4
FY91	$154.5

Table 23

Atomic Vapor Laser Isotope Separation (AVLIS)
($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
Operating	$146.5	$204.3
Capital Equipment	$5.6	$ 6.1
Construction	$2.4	$ 3.2
Total	$154.5	$213.6

Subcommittee View

The Subcommittee has strongly supported the AVLIS program and has urged a deployment as early as is practical. The Subcommittee is convinced that deployment of the technology will result in significant funds to the Treasury as a return on investment for the research and development. The Subcommittee is concerned that the economic potential of AVLIS, as well as our technological lead, will be diminished unless there is an aggressive deployment effort and unless efficient fuel cycle interfaces are demonstrated. Accordingly, the 1992 demonstration should focus on not only laser and separator demonstrations at Lawrence Livermore National Laboratory, but also emphasize, in particular, demonstration of product conversion and environmentally-safe feed preparation in prototype facilities currently being built at Oak Ridge, Tennessee. Contacts with the commercial fuel cycle industry and utilities should be maintained to ensure that maximum economic and environmental AVLIS benefits are achieved. Out of the authorized funds, the Subcommittee directs that $26.2 million of operating expenses and $1.1 million of capital equipment be authorized for the uranium processing program, as outlined in the deployment plan.

DOE planned to issue a request for proposal (RFP) for a deployment contractor in late FY90 or beginning FY91. This RFP has not been issued, and consequently much needed industrial influence and practical business acumen has not been injected into the program. The Subcommittee does not accept DOE's decision to postpone pre-deployment activities and believes the resulting delay will further jeopardize the U.S. position in the enrichment market place.

While the decision regarding construction will not be made until after the completion of the demonstration, there are certain activities which should be performed now, such as in-depth understanding of the technology by a potential plant operator; licensing activities with the Nuclear Regulatory Commission, which requires a private sector, prospective licensee; and projections of both construction and operating costs.

Table 24

Atomic Vapor Laser Isotope Separation (AVLIS)

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
Operating	$219.3	$212.8
Capital Equipment	$6.1	$8.0
Construction	$3.2	$5.0
Total	$228.6	$225.8

Therefore, the Subcommittee directs that the RFP for the deployment contractor be issued immediately and a commercial deployment contractor or private sector partner be competitively selected without delay and in place by October 1, 1991, or as soon thereafter as possible. The Subcommittee authorizes $20 million to fund selection of a commercial deployment contractor, the deployment contractor's pre-deployment activities for data analysis pending a deployment decision, and pre-application activities with the Nuclear Regulatory Commission. The $228.6 million authorization includes an additional $15 million over the budget request to assist funding for these purposes.

The deployment contractor should begin immediately to develop economic and industrial assessments appropriate to make a decision regarding deployment and/or construction. At the completion of the demonstration, the deployment contractor should prepare a report to Congress which would address economic, market, transition, and financing issues. The report would identify any problems anticipated with preliminary plant engineering or construction of a commercial AVLIS facility, contain a deployment risk assessment, and provide an evaluation of the technology. Information to accompany the final report would include operational procedures, material throughput, energy consumption, component and subsystem reliability and, most significantly, the efficiency of separation. In addition, the deployment contractor is requested to consider the deviations resulting from the less than plant-size configuration of the demonstration. The deployment contractor should also assess and encourage private sector investment into the possible commercial deployment and construction of AVLIS.

Finally, the Subcommittee is concerned that the government recoup as much of its research and development investment as is possible. To that end the DOE is directed to grant authority to its AVLIS contractors, the University of California and Martin Marietta Energy Systems, Inc., to explore, initiate and negotiate Cooperative Research and Development Agreements (CRADAs) for the purpose of finding non-uranium enrichment applications of the various AVLIS component technologies.

C. Isotope Production and Distribution

Program Direction

The Isotope Production and Distribution program is a sole jurisdiction program of the Subcommittee. In FY90, a revolving fund was created to self-finance the program and no further appropriations were required.

In its FY92 budget request, DOE is asking for a borrowing authority in the form of an $8.5 million line-of-credit, for the program to modernize some facilities and to explore new products. The line of credit would remain available until borrowed and would be repaid to the Treasury with interest with revenues from product sales.

Subcommittee View

The Subcommittee is concerned that this program needs considerable attention in order to remain a viable business entity. Furthermore, the viability of this program has significant impact on medical research, treatment, and diagnosis, as well as other research programs throughout the nation and, for some isotopes, the world. The Subcommittee will carefully investigate and examine this program and recommend direction and funding for future years.

The Subcommittee endorses the FY 92 budget request, with the stipulation that this program will be examined in depth regarding its future viability.

D. Fossil Research and Development

Program Description

The Fossil Fuels Research and Development program encompasses three major subprograms: coal, petroleum and natural gas.

Since FY 1981, the Administration's request for the Fossil Research and Development program has been consistently cutback by at least 50 percent from prior year appropriated levels. The FY 1992 request is no exception. From the FY 1991 level of $458 million the DOE has requested a 51 percent reduction to $223 million ($3 million was included in the request for the Fuels program. The Subcommittee considers the Fuels program to be a regulatory support activity and believes it should not be carried in the research and development program). In addition, the DOE has predicated their request on the transfer of $150 million from the Clean Coal Technology program to be used for Fossil Research and Development activities. The Subcommittee does not endorse the low level of funding requested for research and development activities or the transfer of the Clean Coal funding for research and development activities. The requested funding inconsistencies are presented in the following table.

Table 25

Fossil Research and Development

Funding History
($ in Millions)

FY	DOE Request	Approp.
1980	747.6	849.9

1981	1,411.5	1,134.7
1982	435.3	416.9
1983	106.9	217.5
1984	94.0	259.2
1985	202.7	274.9
1986	156.9	310.9
1987	82.8	295.9
1988	161.9	326.9
1989	166.9	380.6
1990	163.6	422.1
1991	202.3	458.8

Table 26

Fossil Research and Development
($ in Millions)

	FY 1991 Appropriations	FY 1992 Request
Basic and Supporting Research	$206	$93
Advanced Technology Development		
MHD	40	0
Fuel Cells	43	22
Petroleum	59	52
Natural Gas	16	8
Cooperative Research and Development	12	6
Supporting Activities	84	42
Total	460	223

1. Coal Research and Development

The coal program is divided among many smaller research subprograms and also funds two major technology development efforts, one for Magnetohydrodynamics (MHD) and the other for Fuel Cells.

The coal program is predicated on three critical national needs to reduce oil imports, to meet environmental requirements, and to improve the marketability of U.S. coal technology.

(1) The need to reduce U.S. oil imports and assure a reliable electricity supply. The program assumes that the U.S. will have a continuing reliance on coal utilization for electricity generation and that reliance will increase substantially by the year 2030. The Current Policy Base assumption put forward in the National Energy Strategy (NES) assumes that consumption rises from 900 million tons of coal use today to nearly 2,600 million tons in 2030.

(2) The need to comply with existing and future environmental requirements. The physical and chemical properties of coal and the emissions of sulfur dioxide, nitrogen oxide, particulates and other impurities necessitate the development of control technologies to mitigate environmental problems. Innovative coal technologies are needed that can economically ensure environmentally acceptable levels of emissions from the utilization of the wide range of U.S. coals. Mitigation of possible global

warming effects requires reduction of "greenhouse gases" particularly carbon dioxide (CO_2). Advanced coal technology development to reduce CO2 output by increasing systems efficiencies is ongoing.

(3) The need to continue to foster new ideas and to improve the marketability of U.S. coal technology and open markets for both U.S. coal and U.S. equipment in the utility, industrial, commercial and residential sectors: the availability of developed and demonstrated coal technologies that will meet environmental problems of industrialized and developing nations can give the U.S. a marketing advantage overseas. The potential also exists to export U.S. coals and U.S. coal using technologies.

The Coal Research and Development program is structured towards development of precombustion, combustion and post-combustion technologies.

Activities within the program are separated into seven subprograms of more basic and supporting research that include Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification and Surface Coal Gasification. In addition to the more basic activities, two major technologies are under development, Fuel Cells and Magnetohydrodynamics. These technology development activities are more advanced and require a larger amount of the federal share of the Coal Research and Development budget. Both technologies require a more consistent level of funding which is expected to increase.

A description of the programs, the FY 1991 funding levels, and the FY 1992 DOE requests follow.

Control Technology and Coal Preparation

The program focuses on advanced physical techniques to remove inorganic sulfur to control emissions from utility boilers. In addition, the programs of Flue Gas Cleanup, Gas Stream Cleanup and Waste Management Research and Development provide support for combustion technologies. The DOE's FY92 request for the subprogram is $22.5 million, a decrease of 60 percent from the FY91 appropriated level of $55.7 million.

Advanced Research and Technology Development (ARTD)

The program addresses specific fundamental scientific and engineering problems by supporting advanced research efforts to develop high environmental performance conversion of coal to liquid for transportation and other superclean coal use technologies. Three subprograms of Coal Utilization Science, Materials and Components and university/national laboratory coal research provide basic research support. The DOE's FY92 request for the ARTD program is $28.8 million, a decrease of 8 percent from the FY91 level of $31.3 million.

Coal Liquefaction

The goal of the program is to provide coal-based liquid fuels at around $30 per barrel by the mid-to-late 1990's. Subprograms are Advanced Research, Direct and Indirect Liquefaction, and Support Studies/Engineering Evaluations. The FY 1992 request is $17.1 million, a decrease of 60 percent from the FY 1991 level of $42.6 million.

Combustion Systems

The goal of the program is to develop innovative combustion systems that use coal more efficiently and in a more environmentally acceptable manner. The Advanced Research subprogram focuses on generic and fundamental coal research. Two subprograms directed at technology development are the Advanced Fluidized Bed and the Pressurized Fluidized Bed Technology. In the fluidized bed technology the fuel is combusted with a bed of solid particles which absorbs sulfur dioxide, turning it into a dry benign solid waste. The equipment operates at near atmospheric pressure thereby reducing the formation of NOx. The advantage of the technology is the potential for high efficiency, lower capital and operating costs, coal-type flexibility and better environmental performance. The Advanced Combustion technology subprogram emphasizes the superclean emissions control systems that will use coal and coal-based fuels to displace oil and gas. Finally, the Alternative Fuels Utilization program will establish the generic technology base for the use of coal-based slurry, liquid and solid fuels. The FY92 request is $18.6 million, a decrease of 49 percent from the FY91 level of $36.9 million.

Heat Engines

The program has supported research on overcoming the technical barriers associated with combustion, corrosion, deposition, wear and particulate control when burning dry, slurried or gaseous coal fuels in turbines and diesels. The DOE's recommendation for FY92 is to close-out this activity. The FY91 level was $23.6 million.

Underground Coal Gasification

Underground coal gasification technology converts in-situ coal to a cleaner burning gaseous fuel. The program has four major areas of emphasis: resource evaluation and characterization; process technology development; environmental impact mitigation; and technology transfer. The DOE recommends close-out of this activity in FY92. The FY91 level was $790 thousand.

Surface Coal Gasification

The program supports development of advanced coal gasification systems. The activity is comprised of five subprograms: (1) Advanced Research - fundamental research on basic coal science including systems and concepts establishing the technology base for production of hydrocarbon-based transportation fuels from coal; (2) Systems for Power Production - efforts are focused on achieving better economic and fuel conversion efficiencies for integrated gasification combined cycle systems; (3) Systems for Industrial Fuel Gas Production - efforts to find methods to improve economics for using coal-derived fuel gas in industrial processes; (4) Systems for Synthesis Gas Production - providing new and lower cost methods for producing hydrogen from coal for use in producing liquid transportation fuels through direct liquefaction; and (5) Systems for Coproducts Production - research directed toward producing the technology development needed to optimize the simultaneous production of solids, liquids and gases through use of mild gasification processes. The FY92 recommendation for the Surface Coal Gasification program is $5.3 million, a decrease of 64 percent from last year's appropriated level of $15 million.

Fuel Cells

A fuel cell is an electrochemical energy conversion device which produces electricity directly through the oxidation of a fuel. Fuel cell programs within the Fossil Research and Development budget include phosphoric acid, molten carbonate, solid oxide and other advanced systems. The fuel cells will offer significantly higher fuel conversion efficiencies, fuel flexibility, modularity, and increased environmental benefits over many conventional technologies. The DOE's research effort is to develop fuel cells using natural gas as a first fuel. Further development will use coal as a fuel.

The DOE contends that Phosphoric Acid fuel cells are nearly commercial and that no further research and development funds are required. Molten Carbonate fuel cells are at a mid-level stage of development. A broad based joint venture corporation has been established to further the technology and to develop manufacturing capability for Molten Carbonate fuel cells in the United States. The corporation consists of the Institute for Gas Technology, the Electric Power Research Institute (EPRI), utilities, manufacturers and others. The Corporation is providing 20 percent of the funding in cost-sharing the project with the DOE. The gas-using cell is anticipated to be ready for demonstration in the mid-1990s with commercial use beginning in about the year 2000.

The third technology is the solid oxide concept. A major difference between the Molten Carbonate and Solid Oxide is the electrolyte. The liquid electrolyte used in Molten Carbonate must be replenished during the operating life of the cell. The Solid Oxide cell uses a solid-state device which may simplify operation and maintenance of the cell. The solid oxide fuel cell development is a longer-term activity with anticipated commercialization in about the year 2005. The FY 1992 request of $22 million is a 48 percent decrease below the FY 1991 appropriation levels of $43 million.

Magnetohydrodynamics (MHD)

The MHD technology is based on the concept of using flowing ionized gases or liquid metals, which have been heated by a chemical fuel, as the moving conductor in an electric generator. By using the working fluid directly, the MHD generator removes the intermediate steps of generating steam and turning a turbine. Utilizing working fluids at higher temperatures than conventional powerplants can lead to increased conversion efficiencies in the 50-60 percent range as opposed to existing coal-fired plants that operate with efficiencies in the 32-35 percent range. The technology offers environmental benefits of greatly reduced emission of Sulfur Dioxide (SO_x), Nitrogen Oxide (NOx), and Carbon Dioxide (CO_2) and particulates.

The program has been funded by the DOE since 1977, although some early funding was provided by the DOE predecessor agency. P.L. 99-190, House Joint Resolution 465, Further Continuing Appropriations for FY 1986, contained language mandating cost sharing by the private sector. It is anticipated that the Proof-of-Concept stage should be complete in 1993. The DOE no longer requests funding for the project although funding has been provided through the appropriations process each year. The next stage for the technology will be demonstration, which is anticipated to cost approximately $300 million. According to testimony received by the Subcommittee, the developers intend to apply for Round Five of the Clean Coal Technology (CCT) Demonstration program. The Department did not request funding for the program in FY92.

2. Petroleum

The Petroleum Research and Development Program is divided into three components: Advanced Extraction and Process Technology; Enhanced Oil Recovery; and Oil Shale. The Advanced Extraction and Process Technology program pursues new concepts to achieve increases in efficiency and cost reduction of recovery techniques for oil, gas, oil shale, tar sands and underground coal gasification. The program provides much of the fundamental research that is relevant to oil, gas and oil shale.

The largest component of the petroleum activity is the Enhanced Oil Recovery program. The program focuses on developing advanced extraction technologies to capture additional oil left behind in reservoirs because it cannot be recovered using conventional technology. Improved reservoir characterization, analysis and field verification of reserves are also a major focus of this effort.

The Oil Shale program involves the advancement of extraction and conversion processes to convert oil shale to liquid fuels. Technology developments are focused on reducing the costs of extraction and conversion. The DOE's FY92 request is $52.1 million, a decrease from FY91 levels of 12 percent. In addition to the decrease in funding requested, the DOE also proposed to close-out ongoing research and development on Oil Shale.

3. Natural Gas

Unconventional Gas Recovery

The DOE has maintained a small effort on developing technologies to extract gas from unconventional sources such as lenticular tight gas sands, Eastern Devonian shales, gas hydrates, coal bed methane and deep source gas. Extracting gas from the unconventional sources are long-term efforts. The FY92 request is $8 million, a 50% decrease below FY91 appropriated levels of $16 million.

4. Cooperative Research and Development

The Cooperative Research and Development program was created in FY89 to provide the Federal share of support for Jointly Sponsored Research Programs (JSRP) at the Western Research Institute (WRI) and the University of North Dakota Energy and Environmental Research Center (UNDERC). Congressional direction also expanded the program to include a cost-shared agreement with the State of Illinois. The research projects receive at least 50 percent cost sharing from non-federal partners. Projects run the gamut of Fossil Research and Development research such as, oil shale process studies, tar sands research, and combustion of low rank coals. The request for Cooperative Research and Development activities for FY92 is $6.0 million, a decrease of 50 percent from the FY91 level of $11.8 million.

5. Supporting Activities

Within the Fossil Research and Development account there are also supporting activities of Program Direction and Management Support, Plant and Capital Equipment, and Environmental Restoration. The FY92 request of $43 million is a reduction of 50 percent below the FY91 appropriation levels.

The Subcommittee authorizes an overall level of funding for Fossil Research and Development for FY92 of $471 million, a 3 percent increase above the FY91 appropriated level of $458. For FY93 the Subcommittee authorizes $507 million. The Subcommittee authorizes the following allocation of funds for the FY92 and FY93 activities in the Fossil Research and Development program.

Table 27

Fossil Research and Development

Authorization Recommendation
($ in Millions)

	FY 1992	FY 1993
Basic and Supporting Research	$206	$214
Advanced Technology Development		
MHD	$41	$28

Fuel Cells	$48	$60
Petroleum	$70	$90
Natural Gas	$23	$26
Cooperative Research and Development	$6	$7
Supporting Activities	$77	$82
Total	$471	$507

Coal

For FY92 the Subcommittee authorizes the following levels. For the Basic and Supporting Research activities which includes Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification, the Subcommittee authorizes $206 million. The Subcommittee authorizes $214 million for the activities in FY93, an increase of 4 percent for inflation. In the Advanced Technology Development Activity, the Subcommittee authorizes $48 million for FY92 to fund ongoing fuel cell research and development activities; for FY93, the Subcommittee authorizes $60 million. The Subcommittee directs the Department to give priority to continuing development of Molten Carbonate and Solid Oxide Fuel Cells. A substantial financial commitment has been made to the continued development of Molten Carbonate Technology by the Department of Energy partners. It is anticipated that the non-federal commitment to Molten Carbonate fuel cell development will be approximately $100 million over the next four years. This important funding commitment by the private sector should be met by a predictable funding commitment by the federal government.

For MHD the Subcommittee authorizes $41 million for FY92 and $28 million in FY93. The Subcommittee does not endorse funding the research and development project after FY93. Approximately $650 million of federal funds have been used to develop the MHD technology. The Subcommittee has received testimony that the Proof-of-Concept will be ready in time to apply for Round Five of the Clean Coal Technology program. The Subcommittee encourages the project developers to meet the Round Five deadline and compete for demonstration funding.

Petroleum

The Administration's National Energy Strategy (NES) emphasizes increasing our domestic ability to recover oil left in reservoirs by conventional drilling techniques. Large reserves exist but need advanced technology to extract the oil. The Subcommittee believes that the $52 million requested for FY92 is inadequate to fund the needed activities and authorizes that the funding for Petroleum Research and Development be increased to $70 million in FY92. The Enhanced Oil Recovery program has the potential to provide the largest near and mid term enhancement to our energy security and a reduction in our nation's oil imports. The Subcommittee believes that the EOR potential warrants accelerating the development. The Subcommmittee also believes in the need to continue a modest effort to maintain a core oil shale research and development program, including the scale-up of eastern oil shale technology, and does not endorse the DOE's request for close-out of the activity. For FY93 the Subcommittee authorizes $90 million for Petroleum Research and Development. The Subcommittee also realizes the importance of the Independent Producer in achieving domestic energy security, and urges the Secretary to work closely with the independent producer community in developing future advanced oil recovery technologies.

Natural Gas

The DOE is restructuring the Unconventional Natural Gas program and the budget is reduced by 50 percent to $8 million. The ongoing program, already substantially cost-shared by the private sector, will be discontinued. The DOE plans to only fund cost-shared projects. The Subcommittee believes that the goals of the Unconventional Gas Recovery program as stated in the budget submission are undefined. In 1990, the DOE submitted to Congress a Gas Research Program Plan that provided guidance for a time-phased national research and development strategy to provide a basis for greater utilization of the nation's natural gas resources. The five year plan called for expenditures for FY92 of $24 million and for FY93 of $25.4 million. The Subcommittee does not agree with the proposed program reorganization and urges the DOE to continue its current activities to their logical conclusion. In addition the Subcommittee authorizes that the funding for FY92 be increased to $23 million and for FY93 authorizes $26 million.

It is the Subcommittee's opinion that joint programs with industry involving cost sharing and other resource commitments by all the parties, carries with it obligations to be a responsible partner. In such cases, major program changes should only be made after consultations with the parties involved.

Cooperative Research and Development

For FY92 the Subcommittee endorses the Department's request of $6 million. For FY93 the Subcommittee authorizes $7 million to continue activities.

Supporting Activities

For the Supporting Activities of Program Direction and Management Support, Plant and Capital Equipment and Environmental Restoration, the Subcommittee authorizes $77 million for FY92 and $82 million for FY93. The increase above the request of $42 million reflects the programmatic increases proposed by the Subcommittee.

Fossil Research and Development Cost-Sharing

The FY 1992 DOE budget request for Fossil Research and Development includes a greater emphasis on private sector cost-sharing. The Subcommittee believes that the recent emphasis on cost-sharing for even the smallest project is budget driven. The Subcommittee is concerned that smaller companies who have established research integrity will be precluded from participating in the federal program for lack of early capital investment. In prior years the Subcommittee has endorsed the concept of cost sharing of appropriate projects such as Clean Coal Technologies or specific project joint ventures to leverage scarce research dollars.

The Subcommittee is concerned that the increased application of cost-sharing is proceeding without careful consideration of its consequences. Therefore, the Subcommittee directs that the DOE establish appropriate guidelines for cost-sharing that consider the nature of the project (basic research, technology development or technology demonstration), the costs for completion, and the appropriateness of cost-sharing for the particular research and development endeavor. In addition, the DOE should establish a process for timely approval that will allow industry to begin the proposed cost-shared research in a timely manner. The Subcommittee recommends that the DOE consider different levels of private sector cost-sharing depending on the scope and cost of the project. Finally, the DOE should include in the guidelines provisions governing the use of data, rights, and ownership of the research results or technologies developed. Results of the study should be provided to the Subcommittee upon completion.

The Subcommittee is concerned that the DOE, in its efforts to obtain funding, is losing sight of the basic objectives of the research and development programs and that of cost sharing. Cost-sharing can be an effective and useful addition to the DOE's research and development programs in that it provides a clear indication of commercial interest, but it must be used thoughtfully and appropriately to achieve the desired objectives.

V. GENERAL POLICY GUIDELINES

A. Construction of Major Research and Development Facilities

One objective of the Subcommittee is to provide authorizations to support essential major research and development facilities at the least capital cost to the government. For purposes of this Act two classes of construction projects have been specified. Substantial construction projects for research and development facilities are those for which the estimated cost of construction exceeds $10 million but is less than $100 million. Major construction projects are those for which the estimated cost of construction exceeds $100 million. The estimated cost shall include all experimental equipment to be installed such as accelerators, complete with controls, supporting equipment and utilities.

The Subcommittee requires that each Substantial Construction Project must be authorized in its entirety prior to the start of construction. The Subcommittee believes that the long term implications of both total project costs to build research and development facilities and commitments to additional operating costs to run such facilities must be carefully weighed before funding is provided to start construction. The building of a major facility includes planning, design, construction, emplacement of heavy equipment, installation, checkout, and testing ready for initial use.

Regarding major construction projects, the Subcommittee is concerned about three primary problems in the way DOE facilities are authorized, constructed, and made ready for operation. The first problem relates to the lack of accurate data to support authorization decisions. The second problem relates to the orderly conduct (continuity) of the project. The third problem relates to an annual appraisal by the DOE with "Estimate to Complete Data" furnished yearly to the Congress in the form of following year projections. Such appraisals shall be included in annual budget requests. Accordingly, the Subcommittee directs the following actions for FY92 with the expectation of repeating these requirements in subsequent years.

(1) All Major Construction Projects Research and Development Facilities shall include the following phases:

(a) Conceptual Planning: This phase should to the extent possible, include all supporting facilities such as electric power, water, sewer, communications, etc. The most important aspect of this planning stage is the substantiation of the absolute need for the proposed facility. Meetings and discussions among members of the research community and representatives of the DOE are to cover the potential benefits of the intended research in relation to other possible experiments and research performed at a different kind of facility which could be more beneficial to the public. The merits of the proposed facility compared to other new facility options is to be covered in detail in a report to Congress. That report is to be submitted along with the next annual budget request after the initiation of conceptual planning. Conceptual planning is not to include any reference to specific site locations.

(b) Title I, Conceptual Design: This phase must include engineering personnel familiar with the type of facility to be constructed. Engineers will work closely with user groups to further define the facility requirements and make rough cost estimates for building the complete facility, including all instrumentation. No cost estimates will take credit or make allowances for contributions by industry, state, or foreign governments or any other body.

(c) Title II. Preliminary Design: At this stage, additional design detail will be provided in the form of preliminary drawings and specifications made by engineers and reviewed and approved by user groups. Again, no reference is to be made to any specific site locations for the facility. Site locations will only be considered in Title III activities. In addition, a unit price estimate of the total project cost shall be made to support further continuance with the project. (A unit price cost estimate is one made by allowing so much for a unit of material in place. For example, $125 per cubic yard of reinforced concrete.) Again, no allowances will be made for "outside" contributions. Finally, when necessitated by the nature of the facility and/or its use, Title II shall also include a complete Environmental Assessment or Environmental Impact Statement as required by law or as needed in the opinion of the DOE. Finally, and in addition to the estimate for final design and construction of facilities, a complete, detailed operating cost estimate by year covering the intended useful operating life of the research is to be furnished before funds will be authorized for final design and construction. This estimate is to be prepared by the research community and approved by the DOE. It shall include scientific personnel, technicians, operations and maintenance personnel, office personnel, utility costs, supplies, supporting equipment and other expenses. This estimate will not only be used by the Congress to render a sound judgement in deliberating over authorizations, but could be used as an upper ceiling on future year authorizations. This estimate will also identify any offset associated with facilities that would be closed out by the proposed facility.

(d) Title III. Final Design: Final design includes site selection, general specifications, shop drawings, and equipment detail specifications, complete and ready for construction to be performed. Title III also shall include detailed cost estimates made on a "time and material" basis prepared by professional engineering estimators with supporting substantiation in the form of subcontractor quotations. These detailed estimates shall be based on a specific location.

(e) Title IV. Construction: The activities related to the physical construction of the facility, including land acquisition and site preparations.

(2) The Subcommittee recognizes that in the past the DOE may have defined the above referenced "Titles I through IV" somewhat differently. Nonetheless, the Subcommittee has based its position on the definitions presented above.

(3) The Subcommittee strongly believes the Federal budget situation is such that the government can no longer afford to embark on vast projects only to discover, at some later point in time, the cost to be more than can be afforded. At that time, the project can be abandoned or changed in scope only at great loss to the government. Therefore, it is imperative that the project cost be estimated accurately, to the extent possible, before full authorization is made. The Subcommittee recognizes this concept could, in certain circumstances, result in some additional cost to projects as a result of a delay in starting construction. However, this additional cost is considered to be significantly less than that which is frequently incurred by initiating projects before they are well defined.

(4) The Subcommittee, in taking this action, will authorize Major Construction Projects for research and development facilities in two steps. The first step will provide for "Conceptual Planning, Title I, and Title II". It will not provide for Title III, land acquisition, long-lead procurement or any physical construction. The second step in authorizing such facilities will be based on a Congressional evaluation of the merits of each Major Research and Development Facility relative to the estimated cost and

absolute need for such facilities. The first step will be authorized in response to a budget request from the DOE which identifies the full scope of the project, the need for the facility, the amount of the authorization needed for the first step, and the date of completion of Step 1.

Step 2 will not be authorized unless and until the DOE submits complete detailed cost estimates prepared in Step 1. These estimates shall include all costs (including design, construction, and operation for a specific period), schedules, personnel requirements, and a management plan. When necessary, because of the nature of the facility, a complete detailed Environmental Assessment or Environmental Impact Statement shall be submitted with the estimates, plans, statement of need, and contingencies related to the facility. This information must be submitted with the budget request.

(5) The Subcommittee is equally concerned about the orderly conduct of Major Research and Development Facilities from the standpoint of optimizing design and construction schedules in order to minimize cost. The Subcommittee is aware of the detrimental impact the annual budget process has on large capital-intensive projects. Not only is project management made more complicated, but subcontracts often have to be changed to accommodate project funding. These changes almost always result in additional cost without benefit to the government. Therefore, as a matter of policy, the Subcommittee will endeavor to authorize funding for Major Research and Development Facilities as far in advance as possible. In this regard, the Subcommittee may introduce legislation to provide for full authorization of Title III in "no-year-money".

(6) The Subcommittee is also concerned about the vigilance and timely reporting of progress and problems on Major Research and Development Facility projects. Recognizing the DOE's responsibility to oversee such projects, if not actually manage them, the Subcommittee expects the DOE to be fully aware of actual expenditures and commitments relative to planned expenditures and commitments, as well as actual progress, at all times. Therefore, the Subcommittee directs the DOE to provide such information as may be required for all "ongoing" Major Research and Development Facilities in FY92 by including them in its budget request for FY93. At a minimum, the DOE is to furnish milestone progress schedules showing actual progress versus planned and financial schedules showing actual expenditures versus planned for each and every active Major Construction Projects for a research and development facility. This information is to include complete outyear estimates through project completion.

Two prospective major construction projects are currently undergoing Preliminary Design Activity and are planned to enter formal construction status in FY93. Both of the projects, the Advanced Neutron Source (ANS) and the Burning Plasma Experiment (BPX) have undergone extensive conceptual design work, safety analysis and other activities related to siting and construction. The Subcommittee recognizes that it would be difficult at this time to adapt these two projects to the procedures spelled out above. Therefore, it is the Subcommittee's intent that both of these projects be excluded from the letter of the law in terms of reporting and approval schedules and requirements. However, the Subcommittee believes it is equally important that they follow the "spirit of the law". Therefore, the DOE should provide as soon as practical after completion of the Title II, Preliminary Design Activity for both projects, the equivalent information including total project costs, schedules and commitments for operating costs. The DOE should likewise identify any facilities to be closed out as a result of the availability of the new facilities.

B. Fast Flux Test Facility Research Reactor User Complex

The Subcommittee fully supports the establishment of the FFTF as a multi-mission research and development center (Research Reactor User Complex (RRC)) which will be operated by the DOE in partnership with international and domestic user organizations.

The Subcommittee supports authorizing agreements between DOE and non-Federal entities (which includes foreign governments, and other entities) or a consortium of such entities to use the FFTF RRC for: (1) the production of industrial and medical isotopes; (2) irradiation services which supports research and commercialization objectives; and (3) production of steam.

The establishment of the FFTF RRC by DOE should take place within 90 days of enactment. Agreements between DOE and non-federal entities, including foreign governments and entities, is authorized. DOE is also provided with authority to assess necessary or appropriate charges from the non-Federal entities and to make agreements with the non-Federal entities for no more than 25 years.

C. Annual Budget Submission

The Subcommittee is concerned that the current one year budget submissions by the agency provides an inadequate basis for assessing research and development programs or providing policy or authorizing guidance. Most research and development projects for energy technologies require several years and, in some cases, decades from concept to commercialization. The current practice of overseeing these programs and projects on the basis of a one year budget leads to judgements based on wholly inadequate information. Commitments are often made with little understanding of the outyear costs or payoffs.

The Subcommittee believes that both the agency and the Congress need a better basis for evaluation and decision making. The funding constraints under which both the agency and Congress must operate for the foreseeable future necessitate a more thoughtful, better informed approach. This is particularly relevant to research and development programs.

The Subcommittee, therefore, shall require that the Secretary of Energy provide to the Congress annually a three year budget for the programs under the Committee's jurisdiction. These programs are: Energy Supply Research and Development; General Science and Research; Uranium Enrichment; Isotope Production and Distribution Fund; Nuclear Wate Fund; Departmental Administration; Fossil Energy Research and Development; Clean Coal Technology; and Energy Conservation Research and Development. It is recognized by the Subcommittee that the outyear estimate may change significantly, nevertheless, the best available estimate at the time of budget preparations provides for intelligent assessment based on the best available information at that time.

D. Authorization Restriction

Program Authorization Provision

The Subcommittee believes that the selection and funding of projects without the authorizing legislation in place is a widespread practice and one that should be discouraged. The obligation of scarce federal funds to projects that have not been authorized may severely impact the direction, guidance, and funding levels provided by appropriate authorizing procedures and may lead to wasteful government spending.

COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
U.S. House of Representatives
Washington, DC 20515

May 17, 1991

MEMORANDUM

TO: GEORGE E. BROWN, JR., Chairman
Committee on Science, Space, and Technology

FROM: JAMES H. SCHEUER, Chairman
Subcommittee on Environment

SUBJ: Report of the Subcommittee's actions on the Authorization for the Department of Energy's Solar and Renewable Energy; Energy Conservation; Environment, Safety, and Health; Liquefied Gaseous Fuels Spill Test Facility; and Biological and Environmental Research Programs for Fiscal Years 1992 and 1993.

On May 2, 1991, the Subcommittee approved, by unanimous voice vote, a Subcommittee mark-up vehicle authorizing appropriations for Department of Energy programs within the Subcommittee's jurisdiction.

A copy of the Subcommittee vehicle as approved together with background material on the programs and proposed report language are attached for your review.

SOLAR AND RENEWABLE ENERGY

	FY 91 Estimate	FY 92 Request	FY 92 Recomm.	Rec. vs. Request	% Over Request
		(THOUSANDS)			
SOLAR	124,754	139,666	225,454	85,788	61
GEOTHERMAL	27,252	20,170	23,000	2,830	14
ELECTRIC ENERGY SYSTEMS	27,998	30,757	32,757	2,000	7
ENERGY STORAGE SYSTEM	12,746	7,246	10,246	3,000	41
TOTAL	192,750	197,839	291,457	93,618	47

Descriptions of Changes

The Subcommittee authorizes the Department FY 1992 budget request of $197,839,000 with an increase of $93,618,000 and further recommends an authorization level of $335,176,000 for FY 1993.

In the Solar Program, the Subcommittee authorizes an increase of $3,026,000 for Solar Building Technology including solar heating research and solar buildings energy systems research; $14,200,000 for Biofuels Energy System including crop development and demonstration, thermochemical conversion, biochemical conversion, and direct combustion; $11,056,000 for Wind Energy Systems in the areas of structural and fluid dynamics, development of an advanced wind turbine, storage technologies, development of advanced hybrid systems, component research and cooperative research with the private sector; $29,506,000 for Solar Thermal including research to develop solar detoxification technologies, collection technology research, energy conversion technologies, distributed receiver technology; $28,000,000 for Photovoltaic research including collector research, systems research aimed at integrating this technology into utility sector, development of advanced thin-film materials in cooperation with the private sector and development of cost effective high efficiency materials; and increased program direction.

The Subcommittee authorizes $23,000,000 for the Geothermal Program which reflects a $2,830,000 increase in funding for hydrothermal resources R&D including technology transfer activities.

The Subcommittee authorizes $32,757,000 for the Electric Energy Systems Program which includes an increase of $2,000,000 for DOE participation in the development of a national research program in cooperation with the Environmental Protection Agency and the private sector on the possible health effects of exposure to electromagnetic fields (60 hertz). The costs of such a national research program are to be shared equally by the private sector and the federal government.

An increase of $3,000,000 for hydrogen research including production, storage system development and end-use technologies is contained in the Energy Storage Systems Program which is authorized at $10,246,000. The costs of such a research program will be shared equally by the private sector and federal government.

ENERGY CONSERVATION

	FY 91 Estimate	FY 92 Request	FY 92 Recomm.	Rec. vs. Request	% Over FY 92
		(THOUSANDS)			
Building Tech.	35,088	38,937	70,000	31,063	80
Industrial Tech.	80,269	97,110	120,000	22,890	24
Transportation Tech.	81,759	104,668	134,000	29,332	28
Utility Tech.	4,249	6,800	11,000	4,200	62
TOTAL	201,365	247,515	335,000	87,485	35

Description of Changes

The Subcommittee authorizes the Department FY 1992 budget of $340,000,000 for Energy Conservation which includes an increase of $88,885,000 and recommends an FY 1993 authorization of $392,150,000.

The Subcommittee authorizes $70,000,000 for the Building Technologies Program in FY 1992 which contains an increase of $31,063,000 for additions to the core program in solar technologies research including daylighting analysis and electrochromic window technology; development and implementation of a cost sharing project with private industry and states on high performance envelope integration of solar energy into energy efficient buildings; materials and development; lighting and appliances; heating and cooling equipment including joint ventures for testing new heat pumps in cooperation with the Gas Research Institute; indoor air quality research; building system research; and increased program direction.

The Subcommittee authorizes $120,000,000 for the Industrial Technologies Program for FY 1992 with an increase of $22,890,000 for core programs in the following areas: demonstration project with gas industry to evaluate the technical and economic feasibility of using oxygen rich waste streams from nitrogen supply systems in industrial cogeneration systems; development and testing of ceramic prototypes for blades, rotors, combustor and recuperator; expanded separation technology research; development of continuous fiber ceramic composites to improve energy efficiency; expanded program in engine combustion processes and materials development; improved electrical drives, expanded industrial waste research; design of planar solid oxide fuel cell and application demonstration to be done on a cost shared basis with the Gas Research Institute and private industry; and increased program direction. This authorization also includes $18,000,000 for continuation of activities under the Steel and Aluminum Energy Conservation and Technology Competitiveness Act of 1988.

The Subcommittee authorizes $134,000,000 for the Transportation Program which contains an increase of $29,332,000 for the core programs in the following areas: a project to reduce the cost of producing ceramic automotive components and improve machinings and finishings; tribology R&D to solve materials related problems and accelerate the introduction of alternative low emissions fuels; engine optimization program using alternative fuels; comparative study of light vehicle source energy and fuel utilization efficiency; electric and hybrid propulsion systems development and testing; development and demonstration of advanced ceramic technology for use in automotive gas turbines; design and development of engines for heavy duty trucking applications; zero-emission hydrogen vehicle joint venture and study; and increased program direction.

The Subcommittee authorizes $11,000,000 for the Utility Technologies program which contains an increase of $4,200,000 for integrated resource planning activities.

ENVIRONMENT, SAFETY, AND HEALTH PROGRAM

	FY 1991 Estimate	FY 1992 Request	FY 1992 Recomm.	FY 1993 Recomm.
		(THOUSANDS)		
SPECIAL PROJECTS	10,500	10,920	10,920	
ENVIRONMENT	17,500	18,240	18,240	
SAFETY AND QUALITY ASSURANCE	26,915	24,620	24,620	
HEALTH	51,331[a]	62,239	62,239	
PLANNING	4,100	4,100	4,100	
PROGRAM DIRECTION	20,268	20,590	20,590	
CAPITAL EQUIPMENT	1,533	1,600	1,600	
TOTAL	96,322	142,309	142,309	156,540

[a] This amount is the FY 1991 request adjusted to reflect reprogramming during FY 1991 of epidemiologic research from other program areas to the ES&H program. The actual FY 1991 appropriated level before reprogramming was $15,506,000.

The Subcommittee authorizes the Administration request of $142,309,000 for the Environment, Safety, and Health program for FY 1992, and $156,540,000 for FY 1993.

LIQUEFIED GASEOUS FUELS SPILL TEST FACILITY

	FY 1991 Estimate	FY 1992 Request	FY 1992 Recomm.	FY 1993 Recomm.
	(THOUSANDS)			
OPERATION	1,079	1,115	1,115	
RESEARCH	—	—	1,000	
TOTAL	1,079	1,115	2,115	3,000

The Subcommittee authorizes the Administration FY 1992 budget request of $1,115,000 for this program, with an increase of $1,000,000 for research activities pursuant to Sec. 901 (f) of P.L. 101-549, the Clean Air Act. The Subcommittee recommends an authorization of $3,000,000 for FY 1993, of which at least $1,775,000 is to be spent on research activities.

BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM

	FY 1991 Estimate	FY 1992 Request	FY 1992 Recomm.	FY 1993 Recomm.
		(THOUSANDS)		
ANALYTICAL TECHNOLOGY	13,661	13,290		
ENVIRONMENTAL RESEARCH	36,884	36,888		
HEALTH EFFECTS RESEARCH	64,964	36,598[a]		
GENERAL LIFE SCIENCES	76,916	90,909		
MEDICAL APPLICATIONS	115,361	33,943[b]		
CARBON DIOXIDE RESEARCH	65,528	74,500		
PROGRAM DIRECTION	5,540	6,100		
FACILITIES OPERATIONS	15,018	20,332		
TOTAL	393,872	312,560[c]	311,560[d]	330,500

[a] The apparent decrease from the FY 1991 appropriated level is due to a reprogramming of $25,243,000 for epidemiologic research out of the BER program to the ES&H program.

[b] The apparent decrease from the FY 1991 level is due to a DOE decision not to fund $72,160,000 of congressionally directed projects, mandated in the FY 1991 appropriations legislation.

[c] Adjusting the FY 1991 level to account for the reprogrammed epidemiologic research and the congressionally directed projects results in a 5.4 % increase for FY 1992 in comparison with the FY 1991 level.

[d] This amount reflects an allocation of $1 million to the Liquefied Gaseous Fuels Spill Test Facility.

The Subcommittee authorizes $311,560,000 for this program for FY 1992, and $330,500,000 for FY 1993.

– BACKGROUND –

DEPARTMENT OF ENERGY AUTHORIZATION

A. SOLAR AND RENEWABLE ENERGY

Since 1979, DOE's budget for renewable energy programs has been cut over 90%. Over that same period of time, renewable energy's share in the energy supply R&D funding was reduced from 20% to 4% making it very difficult for these technologies to extend their range of development and application. Despite the comparative advantages of these technologies over fossil fuels in terms of their availability and the extent of the environmental consequences associated with their use, various federal and state policies have served to reinforce a preference for burning fossil fuels. Low petroleum prices in the 1980's caused federal investment in alternative energy supply R&D to dwindle, tax credits for renewable energy investment to be eliminated, and much of the private sector investment in this area to be dissipated.

Renewable sources of energy are found in solar geothermal, hydro, wind and biomass and account for 8% of our nation's energy supply. Technologies to supply energy based on these sources are at various stages of commercial development. For example, hydropower represents a technology that is fully integrated into the energy production scenario while other technologies such as wind, solar and processes that convert biomass to liquid and gaseous fuels are on the brink of being competitive with fossil fuels in a broad variety of applications.

Other nations are spending far greater shares of their energy R&D budgets and in fact, more dollars per capita than the U.S. on renewable energy technologies. U.S. manufacturers of renewable energy systems have been losing ground to foreign competitors in a pattern reminiscent of the decline of the domestic consumer electronic industry in the 1970s.

West Germany and Japan, in particular, have made the development of technologies to support a growing world market for renewable energy use a national priority. Both countries are heavily invested in photovoltaic technology at a level at least twice as high as the U.S. and both have been active in export promotion of these technologies. Although DOE has established the Committee on Renewable Energy Commerce and Trade (CORECT) for the purpose of accelerating the development of the renewable energy infrastructure by supporting exports of renewable technologies, we lag far behind our trading partners. For example, the U.S. has spent $1 million on export promotion across the spectrum of renewable energy technologies, while the European Community spent over $5 million on the promotion of photovoltaics alone. Despite the doubling of the world market for photovoltaic cells in the years 1985 - 1990, the U.S. market share dropped 2% to 32%.

Environmental Concerns

Acid rain and air pollution are consequences associated with the use of fossil fuels to generate energy. There is increasing evidence to suggest that the carbon dioxide that is released in the combustion of fossil fuels is the major contributing factor to the global warming phenomena. International negotiations are currently underway to formulate a treaty on global warming. Although the U.S. has tried to keep the discussions focused on how the loss of tropical rainforests exacerbates climate change, developing countries such as Brazil insist that changes in U.S. energy consumption be considered in tandem with policies to reduce global warming.

While industrialized nations will continue to consume huge quantities of energy and other nations will seek to expand their energy production capacity to facilitate development, it is clear that renewable sources of energy will become more important in the international energy supply portfolio.

National Energy Strategy

The National Energy Strategy (NES) calls for a "continuing increase in research and development (R&D) to reduce costs and improve the performance and efficiency of emerging technologies." Specifically, the NES states the following objectives:

- increase funding for R&D related to renewable energy to reduce the costs of and increase industry confidence in, selecting solar, wind, biomass, and geothermal technologies to generate electric power;
- increase funding for R&D on waste-to-energy systems as a part of a comprehensive waste management program to support the conversion of municipal solid waste to energy;
- increase funding for R&D on new biomass feedstocks and conversion technologies to develop economical liquid fuels from biomass as alternatives to petroleum based fuels; and
- increase funding for R&D on innovative building materials and designs to use renewable energy for direct heating, cooling, and lighting in buildings.

Despite the rhetoric of the NES, the Administration's request for the renewable energy program represents only a 4% increase over the FY 91 level of $157.7 million to $164.1 million.[1] According to figures obtained by Public Citizen, DOE requested a higher level of funding for the renewable energy programs and OMB reduced the Department's request for renewables by 26%. This was done in a context of reducing the overall budget request for energy supply R&D by 14%.

Description of Programs

The **Solar Program** ($142.9 million in FY 92) supports the development of technologies to convert sunlight into electicity or other energy uses. Several major elements of DOE's solar program include: photovoltaics, solar thermal and solar building technologies. A major committment ($50.8 million, up from $46.3 million in FY 91) has been made to developing photovoltaic technology as a competitive peak load electric generation option by the mid-1990s and as an intermediate load capacity by the end of the decade. FY 92 efforts will focus on helping U.S. industry advance manufacturing process technology to the point where photovoltaics is an economically competitive energy option.

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[1] This figure does not include the programs in Electric Energy Systems (EES)($30.8 million in FY 92) and Energy Storage Systems (ES)($7.2 million in FY 92).

The **Renewable Energy Program** includes:

Geothermal programs include research and demonstration projects. DOE's geothermal R&D program ($20.2 million in FY92) focuses on reservoir development and advancements in drilling and conversion technologies.

Wind ($13.9 million in FY92) energy research is focused on improving current wind systems technology, by increasing wind turbine performance, extending design life and developing advanced materials for superior turbines.

Biomass sources of energy, including organic materials and municipal solid waste, can be converted into liquied and gaseous fuels. Biomass combustion currently accounts for approximately 5% of the total energy consumption of the United States, growing from 200 megawatts (MW) in the early 1980s to nearly 8,000 MW currently. These fuels have varied applications: 1)industrial, including the waste-to-energy combustion of municipal solid wastes; 2) transportation, which includes the usage of both ethanol and methanol as an alternative fuel; and 3) electricity production.

Electric Energy Systems (EES) directs research toward solving mid- to long-term problems in electical energy transmission and distribution, and to integrating renewable energy resources into the utility network. The EES budget includes the applied High Temperature Superconductivity (HTS) program and DOE's investigations into the potential health effects from exposure to electric and magnetic fields (EMF).

Energy Storage Systems (ES) supports generic research into electrochemistry and applied battery research. Battery technology is most often cited as the limiting factor for the development of electric vehicles and other applications of renewable energy technologies. The ES budget also includes the Hydrogen R&D programs.

Prior Legislation

The Science Committee has participated in the passage of two bills on renewable energy R&D which will be amended by the FY 92-93 authorization bill under consideration. **The Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989, P.L. 101-218**, authorized funding for FY 91 - FY 93 for part of the solar energy, renewable energy, and energy conservation programs within the Committee's jurisdiction. **The Spark M. Matsunaga Hydrogen Research, Development, and Demonstration Act of 1990, P.L. 101-566**, authorized $3 million in FY 92 funding for hydrogen R&D from renewable energy sources.

B. ENERGY CONSERVATION

Energy is conserved when technical means are employed to improve efficiency or to reduce energy waste. Thus, the terms "conservation" and efficiency" are identified with technological changes to produce a constant level of output or services with less energy. In 1985, national energy use bottomed out at 74 Q (quads -- quadrillion Btus, British thermal units) rising to a record high of 81 Q in 1989.

According to the Department of Energy's Energy Conservation Trends, energy efficiency and conservation activities from 1973 through 1986 curbed the pre-1973 growth trend in energy use by about 32 Q, a 30% reduction that saves the economy about $180 billion annually. Of the 32 Q in savings, 40% comes from industry, 34% from residential buildings, 16% from commercial buildings and 10% from transportation.

Under pre-Iraqi invasion energy price assumptions, DOE's interlaboratory report, "Energy Efficiency: How Far Can We Go?," projects that use of existing cost-effective technology could produce similar savings in the future, trimming as much as 14 Q off of the 102 Q demand projected by the Energy Information Administration (EIA) for the year 2010. These savings come on top of 14 Q in savings already assumed in the EIA projection. Of the 14 Q of additional savings, 40% is expected to come from buildings, 30% from industry and 30% from transportation.

From 1974 through 1980, Congress established several complementary programs, primarily at the Department of Energy (DOE), to implement energy saving measures in virtually every sector of societal activity. These programs were created primarily in response to national security and economic stability concerns. However, progress in the use of more efficient technologies has affected and is likely to continue to affect national interests in industrial competitiveness, electric power, and environmental quality. The Federal program in energy conservation grew rapidly in the 1970s, primarily as a domestic alternative to oil imports. However, program support waned in the 1980s as a result of the Reagan Administration's "free market" energy policy and generally declining energy prices.

Mounting concern about oil imports and the linkage of conventional energy use to environmental problems such as global warming, acid rain and urban smog combined with the issue of energy security (we import 50% of our oil) to generate renewed interest in energy efficiency technologies.

In support of energy security and other national interests, the Federal energy conservation program now includes R&D funding, grants to State and local governments and a regulatory framework of appliance efficiency standards and voluntary guidelines for energy-efficient design in buildings. In addition, there is a regulatory program which allows independent cogenerators to sell electricity to utilities.

Legislative History

Congressional action in the 101st Congress included three key achievements for energy conservation. First, the Congress approved (P.L. 101-512) $226 million in FY 1991 R&D appropriations. In 1982 constant dollar terms, this is $167 million, a 16% real increase over the FY 1990 level. As reported from the Interior Appropriations conference committee (H.R. 5769, H.Rept. 101-971), the FY 1991 budget sets a mark of $497.8 (including $30 million in oil overcharge funding) for energy conservation programs. Key changes from FY 1990 include: an $11 million, or 28% increase for Buildings; a $10 million, or 20% increase for Industry, including a $6 million increase for industrial process efficiency; a $15 million, or 23% increase for Transportation, including $7.6 million more for electric vehicles and $7 million more for alternative fuels; and a $51 million, or 23% increase for State and Local programs, including $38 million more for weatherization.

Second, the State Energy Conservation Programs Improvement Act (P.L. 101-440) updates expired goals for efficiency improvement while lifting spending authorizations and increasing State program flexibility. Third, the Clean Air Act Amendments (P.L. 101-549, Section 404[f]) include a provision creating SO_2 emission offsets for the use of conservation measures and a provision creating monetary penalties for exceeding emission tonnage limits.

Three other significant energy conservation initiatives were enacted by the 101st Congress. First the FY 1990 Foreign Operations, Export Financing and Related Programs Act (P.L. 101-167) directs multilateral banks and the Agency for International Development to give funding priority to energy-efficient technologies based on their environmental profile. Also, the FY 1991 Foreign Operations Act (P.L. 101-513) established a $70 million dollar fund to disseminate information on eastern Europe. Second, the Renewable Energy and Energy Efficiency Technology Competitiveness Act (P.L. 101-218) required certain technology demonstration projects. Third the FY 1991 Legislative Branch Appropriations Act (P.L. 101-520) requires a study of the cost-effective potential for retrofitting energy efficient lighting technologies in congressional buildings.

National Competitiveness

Energy costs American manufacturers over $100 billion annually. Despite recent gains, U.S. industry remains much less energy-efficient than most of its major trade competitors. Improving the energy efficiency of American industry, especially energy-intensive industries like metals and chemicals, can increase competitiveness by reducing the final cost of products. Factors such as relative exchange rates, wages, capital resource availability, foreign government subsidies, and trade barriers also have an influence on product competitiveness.

The nation spends about $440 billion annually for energy, an amount equal to 11% of the Gross National Product (GNP). This is nearly double the percentage used by Japan. Higher U.S. energy intensity is reflected in higher product costs and, thus, lower competitiveness. In contrast, foreign producers faced with higher energy prices and energy taxes have penetrated domestic markets with highly energy-efficient cars and appliances. This pattern is being repeated in markets for industrial motors, lighting equipment and air conditioners. Conversely, U.S. firms have difficulty selling comparatively inefficient products in foreign markets. Also, there is a risk that future energy price increases may accentuate the shift of domestic consumers to imported goods. Thus, the activities of DOE's Industrial Conservation Program are caught up in the larger national question of how the Federal Government can help U.S. industry regain a leadership role in international markets.

Historically, the area of energy efficiency R&D has received very modest funding although DOE's program has been responsible for contributing 2 of the 20 key technological breakthroughs of the 1980s according to the High Technology Business magazine. Both successes have come in the area of materials. In the last twenty years, the conservation R&D program has developed several technologies that have been successfully transferred to the private sector and commercialized. These include a fluorescent lighting technology, developed by DOE which has potential energy cost savings benefits of $3.3 billion by the year 2010.

Description of Programs and Budget

In 1982 constant dollar terms, R&D funding declined steadily from a peak of $428 million in FY 1979 to a low of $127 million in FY 1989 (Attachment 3). The spending level for energy conservation has continued to rise since then with the current budget of $277.6 million reflecting an increase of 27% over the FY 1991 appropriation level.

The Conservation Energy program is broken down into the following categories:

Utility Technologies focused on end-use sector for electric utility related technologies and includes support for integrated resource planning, which will result in reduced demand and increased efficiency. At $6.8 million, the budget for this program is up 60% over FY 91.

Building Technologies Program supports generic research in building systems, with the goal of encouraging optimal energy use in new and retrofitted structures. Research areas in the commercial and residential buildings sector include materials and structures, lighting and appliances, heating and cooling equipment, indoor air quality, and building systems research. The FY 92 request of $454.2 million reflects an increase of 26% over the current fiscal year.

The Federal government itself uses over 2% of all energy used in the United States. The Building Technologies Program also includes the **Federal Energy Management** Program ($4.6 million) which is aimed at improving the energy efficiency of federal facilities and operations by providing guidance and assistance to agencies in planning and implementing energy programs.

Industrial Technologies Program supports research and development of technologies in areas such as waste energy reduction and improved process efficiency which have the potential to increase energy use efficiency in private industry. Key elements of this program to increase industrial energy efficiency are: Materials Processing, Electric Drives, Separations, Sensors and Controls, Bioprocessing, Enabling Materials, improved Combustion Efficiency and Process Heating and Cooling. The program also sponsors R&D on alternative sources of fuels and feedstock including industrial wastes, municipal solid wastes and cogeneration. The budget for this program is $101.9 million which represents an increase of 22% over FY 91.

Transportation Program focuses on research to improve the energy efficiency of vehicle systems including, electric vehicles, advanced vehicle propulsion and alternative fuels. Significant improvements have been made in fuel economy for light duty trucks over the past 15 years however, the fuel savings have been considerably exceeded by increases in the number of vehicles and miles travelled. DOE is emphasizing improved fuel efficiency R&D activities that will lead to the manufacture of more energy efficient, fuel flexible, and environmentally sound transportation technologies during the mid to late 1990s. The FY 92 budget request of $111.2 million is 33% higher than the FY 91 level.

Technical and Financial Assistance Program is mainly responsible for administering grants for energy efficiency measures and disseminating technical information to states. This budget for this program has been reduced 83% to $48 million.

C. ENVIRONMENT, SAFETY AND HEALTH PROGRAM

The Office of Environment, Safety, and Health (ES&H), established by DOE in 1985, is responsible for oversight of all Department of Energy activities to determine wheter they are being conducted in conformance with applicable environmental laws and regulations and in a manner designed to assure that the health and safety of workers and the public are protected. The Office also assures that national environmental protection goals are incorporated in all DOE program areas; assures that environmental, health, and non-nuclear safety concerns are identified and addressed through corrective and remedial actions, and provides liaison with other Federal agencies concerning regulatory efforts that may have an effect on the Department's operations. The Office's oversight responsibilities also extend to the monumental cleanup effort managed under the Environmental Restoration and Waste Management (ERWM) Program, a $3 billion cleanup program in fiscal year 1991.

For more than 40 years, DOE and its predecessors have been producing nuclear material for various purposes (including weapons production and naval fuel) and conducting related research, development, and testing activities. Many of the 50 major facilities that produce and process nuclear material are old and deteriorating and have serious environment, safety, and health problems. The General Accounting Office (GAO) has issued several reports on DOE's management deficiencies in safely operating the nuclear manufacturing activities.

Secretary Watkins has initiated a Ten Point Plan to move the Department aggressively toward full accountability and compliance in the areas of environment, safety, and health. This Plan:

(1) Revamped the system of contractor award fees to significantly increase the importance of safety and health requirements in contractor award fee evaluation.

(2) Established independent "tiger teams" to conduct comprehensive environment, safety, and health compliance assessments.

(3) Provided access to DOE nuclear facilities for State officials monitoring environmental, safety, and health compliance.

(4) Moved to strengthen technical capabilities of line management oversight personnel.

(5) Mandated compliance with OSHA standards in all DOE facilities.

(6) Appointed an independent advisory panel to evaluate changes needed in Department's epidemiology program.

(7) Established a new management team within the Department's Office of Defense Program to emphasize safety.

(8) Directed the development of a Five-Year Environmental Restoration and Management Plan, consolidating cleanup activities and establishing an agenda for compliance and cleanup against which progress can be measured.

(9) Began development of a comprehensive epidemiology data repository containing information on past and present DOE workers that may be used by qualified researchers.

(10) Directed a comprehensive review of the Department's NEPA policy, including recommendations for appropriate revisions.

In response to the Plan, the ES&H Office was reorganized in 1990 to create three Deputy Assistant Secretary positions: Environment, Safety and Quality Assurance, and Health. The DOE has further plans to reorganize ES&H by adding to it the responsibility for ensuring security (e.g., protection from facility intrusion) at each of DOE's facilities. A brief description of the activities and responsibilities for each of the three ES&H offices, as well as the Office of Special Projects, appears below.

The Environment Office tracks and interprets environmental regulations and disseminates the information to the facilities. It lacks any enforcement capability within the agency. It offers guidance and advice to the facilities regarding compliance the major environmental statutues, including the Resource Conservation and Recovery Act (RCRA), Superfund, Clean Air Act, and so on. The office also reviews Environmental Impact Statements for DOE activities required under the National Environmental Policy Act, and conducts audits of facilities other than those which have been audited by the "Tiger Teams."

The precursor studies to the Tiger Team reports were the Environmental Surveys. There is some concern that the final results of the Environmental Surveys have never been released, even though they were promised in 1989. The information in the surveys could be very helpful in setting cleanup priorities for DOE facilities, especially because the surveys included a comprehensive environmental sampling and analysis program to determine the nature and extent of facility contamination.

The Safety and Quality and Assurance Office is now responsible for safety other than nuclear safety, which is now assigned to a newly created Office of Nuclear Safety (ONS). The Secretary made this change to respond to the need to improve nuclear safety practices at facilities; there is some potential overlap between ONS and the ES&H program. The Safety and Quality Assurance Office issues guidelines and orders to the facilities and conducts training sessions to assist the operations programs in meeting safety requirements, primarily those under the Occupational Safety and Health Act (OSHA).

The Office of Health is responsible for monitoring and helping to ensure the occupational health protection of its workers, and for conducting epidemiological studies to determine the cause of worker health problems in the past. A sizeable portion of the epidemiological research ($20 million of a total budget of $62 million for fiscal year 1992) will be administered by the Department of Health and Human Services. Also, epidemiological research conducted in other parts of the agency has been consolidated and transferred to the ES&H program.

The Office of Special Projects, is directly accountable to the Assistant Secretary for ES&H and is responsible for conducting the "Tiger Team" assessments. These comprehensive, one-time facility audits are conducted to assess three primary aspects of facility operation: management and organization, environmental compliance, and health and safety. DOE has completed Tiger Team assessments for 19 sites; a total of 36 sites are planned for review.

D. LIQUEFIED GASEOUS FUELS SPILL TEST FACILITY

This program supports research on the behavior of chemicals in the environment following a spill or other environmental release. Tests conducted at this remote facility are designed to improve understanding of dispersion patterns, combustion characteristics, and environmental effects of chemicals released to the environment, and to evaluate atmospheric dispersion models. Information gained is used to develop mitigation and cleanup techniques and emergency planning guidelines.

This facility is the only one of its kind in the United States that is capable of conducting research which monitors and models the actual release and dispersion of dense gases. At the height of the program's operation, 20 full-time scientists were employed. Subsequent funding cuts have resulting in the dismantling of the uniquely trained unit of physicists that directed this work. The Department of Energy has not taken advantage of the direction, encouragement, and funding that the Congress has provided. The importance of this work makes it imperative that another qualified agency, such as the Environmental Protection Agency, share the responsibility and funding to carry out research. In the Clean Air Act amendments of 1990 the Congress addressed this issue by including specific directives to EPA and DOE on research to be conducted at the Spill Test Facility.

E. BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM

The Biological and Environmental Research (BER) program is administered by the Office of Health and Environmental Research (OHER), in DOE's Office of Energy Research. The program conducts long-term, basic research in the physical, chemical, and biological sciences aimed at the discovery of new concepts that may or may not have immediate technological applications. However, because DOE is a mission-oriented agency, basic research within the department is influenced by national energy and environmental policy. For example, DOE is conducting basic research of groundwater contamination to support the environmental restoration and cleanup of DOE facilities.

The authority of DOE to perform biological research dates from the Atomic Energy Act of 1946 which specified research and development efforts on the use of radiation and radionuclides for medical diagnosis and the treatment of human disease. This has lead to the consolidation of various biological research programs within the Office of Health and Environmental Research that include: human genetics, nuclear medicine, radiation dosage, global environmental change, atmospheric chemistry, and subsurface chemistry and biology to support environmental restoration of DOE's facilities.

Activities under the BER program include:

Analytical Technology. Research is conducted to improve the ability to measure human exposure to ionizing radiation, radon, and toxic chemicals.

Environmental Research. Research areas under this program include atmospheric chemistry relevant to acid rain, smog, and dispersion models for accidental releases of toxic chemicals; ocean pollution; the movement of radon gas in the subsurface environment; subsurface microbiology and chemistry to understand groundwater contamination; and carbon cycling and ecosystem responses to global change.

Health Effects. The epidemiology research portion of this area has been transferred to the Environment, Safety, and Health Program. Research remaining in this area includes studies on carcinogenicity associated with radiation exposure, and research to determine the combined effects of exposure to chemicals and radiation.

General Life Sciences. The largest component in this area is the human genome initiative, a joint project between DOE and the Department of Health and Human Services. Research in structural, molecular, and cellular biology is also conducted which will lead to identification of early indicators of biological damage, estimation of human health risk to radiation and chemical exposure, and to innovations in biotechnology.

Medical Applications. This research involves a wide range of projects, mostly in the area of nuclear medicine, directed to clinical and other beneficial applications of energy-related technologies. Methods are evaluated for the study, diagnosis, and treatment of disease such as cardiopulmonary disease, mental disorders, cancer, and metabolic disorders. Nuclear medicine is a highly sophisticated field in which safe amounts of radioactive material are used in the diagnosis and treatment of disease. Generally, nuclear medicine procedures are of two types: imaging studies, in which measurements are made of radioactive tracers as they pass through the body; and diagnostic examinations, in which no radioactive materials are administered to the patient, but rather a specimen is reacted with a radioactive reagent in a test tube. The field of nuclear medicine was developed largely at DOE laboratories where there has been access to accelerators, reactor by-products such as radioisotopes, skilled personnel, and long-term funding. DOE has pioneered research in radiopharmaceuticals and advanced instrumentation for detecting disease.

Carbon Dioxide Research. This program is designed to improve scientific knowledge of global warming and global climate change, by improving understanding of the quantitative link between increased atmospheric carbon dioxide and global climate change. The centerpiece of the program in FY 1992 is the Atmospheric-Radiation Measurement program, which is a monitoring program designed to improve climate prediction capability.

SUBCOMMITTEE ON ENVIRONMENT

DRAFT REPORT LANGUAGE
DEPARTMENT OF ENERGY AUTHORIZATION

BACKGROUND AND NEED FOR THE LEGISLATION

A. Central Role of Energy Efficiency and Renewable Energy

How the United States produces and uses energy is of fundamental importance for the strength of the economy, the security of our energy supply, the quality of the environment, and the legacy we pass on to future generations. Improving energy efficiency and accelerating the development and deployment of renewable energy technologies and alternative-fueled vehicles can play a central role in the evolution of an energy system that will meet the Nation's long-term needs in an economical and environmentally sustainable manner.

Energy-efficient technologies and energy-saving end-use practices can produce significant energy and cost savings in every sector of the economy.[1] The potential is indicated by the 26% reduction in the energy intensity (the amount of energy used to produce a unit of economic product) of the entire U.S. economy between 1973 and 1986. Total U.S. energy consumption in 1986 was 74 quads (quadrillion Btus–British thermal units, a measure of heat energy), the same as in 1973, while GNP increased 35% during the same period.[2] Some of this reduction in energy intensity was due to structural changes in the economy, but about two-thirds of it resulted from increases in energy efficiency. After the 1973 oil embargo, rising energy costs, concern about potential shortages, and government policy combined to produce major changes in energy use.[3] However, with the mid-1980s drop in energy prices and the decline in Federal support for increased energy efficiency during the Reagan Administration, U.S. energy efficiency gains stagnated. From 1986 through 1990, energy consumption increased 11% while GNP increased 12%.[4]

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[1] Hearing on FY 1992 Authorization for the Department of Energy's Energy Conservation Program, before the Subcommittee on Environment of the Committee on Science, Space, and Technology, U.S. House of Representatives, 102nd Cong., 1st Sess. (April 17, 1991), testimony of Rosenfeld, Ross, Hirst, Guinn [hereinafter cited as "1991 Hearing on Energy Conservation"]. Also see Oak Ridge National Laboratory, Argonne National Laboratory, Lawrence Berkeley Laboratory, Pacific Northwest Laboratories, and Idaho National Engineering Laboratory. 1989. "Energy Efficiency: How Far Can We Go?" (ORNL/TM-11441) report prepared for the Department of Energy, Oak Ridge National Laboratory, Oak Ridge, Tenn. [hereinafter cited as DOE Interlaboratory White Paper on Energy Efficiency].

There is a very large as-yet-untapped potential for greater energy efficiency in residential and commercial buildings, industrial manufacturing, and transportation. Some of this will occur through the operation of market forces and with existing technologies. However, much of this potential is unlikely to be realized without policy changes and an enhanced technology-development effort.

A 1989 DOE interlaboratory white paper entitled "Energy Efficiency: How Far Can We Go?" concludes that cost-effective efficiency improvements would save 24% of total U.S. energy consumption in the year 2010, in comparison with projected consumption if efficiency is frozen at the current level (thus reducing projected U.S. energy consumption from 115.4 quads to 87.9 quads). However, it concludes that the majority of this savings "will not occur without extensive policy changes." The report also concludes that the "additional potential for efficiency improvements beyond 2010 is very large, but much of it will not be realized without concerted research and development efforts by government and industry."[5]

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[2] Energy Information Administration. 1991. "Monthly Energy Review April 1991." Department of Energy, Washington, D.C., at P. 26 [hereinafter cited as EIA Monthly Energy Review].

[3] DOE Interlaboratory White Paper on Energy Efficiency, at P.3. 1991 Energy Conservation Hearing, testimony of Gibbons.

[4] EIA Monthly Energy Review.

[5] DOE Interlaboratory White Paper on Energy Efficiency, at Pp. 2,12,22. A 1990 Electric Power Research Institute study of the estimated maximum technical potential energy savings for a wide range of electrical end-use technologies concludes that, if consumers used equipment rated in the top 20% in terms of energy efficiency, the result would be a saving in the year 2000 of 24 to 44% of projected total U.S. electric

(Footnote continued)

The Director of the Office of Technology Assessment concludes that:

> OTA's studies over the past decade have consistently shown that energy efficiency is an essential cornerstone to a comprehensive energy policy framework....Considerable future energy efficiency gains are still possible in all sectors of the economy using existing technology. Even greater cost savings and efficiency gains will be possible with technologies under current research and development. An efficiency goal of sustained improvement of 2% per year for the next two decades is realistic for the U.S. With more vigorous research on energy efficiency, coupled with leadership and investment, this goal can be met or exceeded–and with options that are certainly no more costly than pursuing the supply-side path. Moreover, pursuing such a goal appeals to all three policy interests of economic health, environmental quality, and energy security.[6]

Renewable energy resources, including solar, wind, biomass, geothermal, and hydropower, have several important advantages. While each is limited in one way or another, collectively they offer a diverse and virtually inexhaustible resource. While each has environmental impacts, the production of energy from renewable sources is,

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[5] (continued)
energy consumption. "Efficient Electricity Use: Estimates of Maximum Energy Savings" EPRI CU-6746. Electric Power Research Institute, Palo Alto, California.

[6] Hearing on National Energy Strategy, before the Subcommittee on Environment of the Committee on Science, Space, and Technology, U.S. House of Representatives, 102nd Cong., 1st Sess. (Feb. 26, 1991) [hereinafter cited as 1991 Hearing on National Energy Strategy], testimony of Gibbons.

on the whole, substantially less damaging to the environment than production from "conventional" sources. Further, as a largely domestic resource, renewable energy development can contribute significantly to our energy security.[7]

Renewable energy comes from solar, wind, biomass, geothermal, hydropower, and other sources. Renewable energy technologies currently supply about 8% of U.S. energy demand, with the largest shares coming from hydropower and wood burning. A diverse and versatile array of other renewable energy technologies, including solar thermal heating and electric, photovoltaic (PV) electricity, wind power, biofuels, and geothermal energy currently supply less than 1%, but the contribution of each is growing and there has been significant progress in technology development and cost-reduction during the past decade.[8]

Renewable energy can play a major long-term role in meeting the Nation's energy needs. A 1990 DOE interlaboratory report projects that, at the current level of research and development support, by the year 2030 renewable energy will provide a domestic contribution of 15% of total energy supply. With a moderate expansion of Federal research, development, and demonstration expenditures over the next 20 years, the report projects that renewable energy sources will provide 41 quads, nearly 30% of the national energy supply, by 2030.[9] This "R,D&D Intensification Scenario" assumes incremental R,D&D funding increases totaling $3 billion, an average of $150 million per year.

It is our opinion that such levels of expenditure have been shown by past efforts

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[7] See Hearing on FY 1992 Authorization for the Department of Energy's Renewable Energy Program, before the Subcommittee on Environment of the Committee on Science, Space, and Technology, U.S. House of Representatives, 102nd Cong., 1st Sess. (April 9, 1991) [herinafter cited as "1991 Hearing on Renewable Energy"], testimony of Davis, Department of Energy.

[8] 1991 Hearing on Renewable Energy, testimony of Brower, Swisher, Becker, Sklar.

[9] Idaho National Engineering Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, Sandia National Laboratories, and Solar Energy Research Institute. 1990. "The Potential of Renewable Energy" SERI/TP-260-3674 DE90000322. Solar Energy Research Institute, Golden, Colorado [hereinafter cited as DOE Interlaboratory White Paper on Renewable Energy].

> to be sustainable and effective, and they would pursue well-defined objectives along identified R&D pathways. Much of the gain projected in our R,D&D Intensification Scenario is due to the acceleration of the technological improvements that private industry would otherwise pursue independently much later in time as economics become more favorable and risks smaller....The key to realizing the potential contributions of renewable energy in the near term is to intensify R,D&D activities. If market factors–higher prices or special markets–appear earlier than projected, the industry will respond in force only after the prerequisite R,D&D has been carried out.[10]

The development of alternative transportation fuels and vehicles to reduce our dependence on oil in the transportation sector can also enhance the Nation's energy security and provide significant environmental benefits.[11] The U.S. transportation sector is almost totally dependent on petroleum: in 1989, 97% of the energy used in transporting people, goods, and services came from petroleum. Transportation accounted for 63% of all petroleum use, or 21.5 quads, more than all domestic production combined.[12] In addition, the transportation system is a major contributor to urban air pollution.

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[10] DOE Interlaboratory White Paper on Renewable Energy, at Pp. viii-ix, xii.

[11] See Hearing on H.R. 1538, National Electric Vehicle Act of 1991, before the Subcommittee on Environment of the Committee on Science, Space, and Technology, U.S. House of Representatives, 102nd Cong., 1st Sess. (May 16, 1991) [hereinafter cited as "1991 Hearing on Electric Vehicles"]. 1991 Hearing on Renewable Energy, testimony of Perry and Jones. A recent study by the Environmental Defense Fund concludes that electric vehicles, as well as some alternative transportation fuels, can reduce greenhouse-gas emissions. Diane C. Fisher. 1991. "Reducing Greenhouse Gas Emissions With Alternative Transportation Fuels." Environmental Defense Fund, Oakland, California, at P. 28.

Electric vehicles (EVs) are an environmentally attractive alternative to petroleum-fueled vehicles, especially in urban areas. By some estimates, EVs show as much as a 97% reduction in emissions of major air pollutants, compared to conventional vehicles. However, there is no significant consumer experience with EVs, which are perceived to be costly and limited in performance, with slow acceleration and limited driving range on one charge of batteries. General Motors' Electric Vehicle, the Impact, which is slated for production in the near future, has an effective range of 125 miles, and its lead-acid batteries have an estimated life of only 20,000 miles. Successful widespread commercialization of EVs depends on addressing issues of technology development, market development, and infrastructure.

A major thrust of ongoing work at the Department of Energy in EVs is in advanced battery development. The goals of this work include longer battery life, increased power, less time between battery charges, and improved durability. The three major U.S. automakers have combined to form the U.S. Advanced Battery Consortium (USABC), to carry out this work in cooperation with DOE. The industry consortium will provide 50% of the funding, and DOE will match that 50%.[13]

America's energy plan must include retooling America's transportation industry so it can run largely on electricity, natural gas, fuel from biomass and, in the future, perhaps hydrogen from solar power. With the electric vehicles on the road, solar power and other renewables will then be able to replace oil. The strategy must therefore focus on:

(1) Conservation–improving energy efficiency especially in transportation

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[12] EIA Monthly Energy Review

[13] 1991 Hearing on Electric Vehicles.

ıg solar power and other renewables

and trucks to run on electricity and other forms of these

ams are advanced by a strong government energy plan, our

w. Government intervention in the market through regulation

ℷD is thus essential to reflect the tragic cost of oil imports and

l warming.[14]

d the development and deployment of renewable energy ıe adverse environmental impacts that result from current ıese impacts include emissions of a broad range of air recursors, as well as land and water contamination resulting :ransport, and waste disposal activities, including the oil spills. Potentially of overarching long-term significance, energy efficiency and greater use of renewable energy ⁄ reduce emissions of greenhouse gases that are destabilizing sphere and threatening uncontrolled global warming.[15]

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al Energy strategy, testimony by Freeman, at Pp. 7-10.

y Assessment, U.S. Congress. 1991. "Changing by Degrees: se Gases," OTA-O-483. U.S. Government Printing Office, fter cited as "OTA Global Warming Report"]; Environmental of Policy, Planning, and Evaluation. 1989. "Policy Options ıate," draft report to Congress. Washington, D.C. Global Warming Policy Options"]; National Academy of y of Engineering, and Institute of Medicine, Committee on Public Policy. 1991. "Policy Implications of Greenhouse

(Footnote continued)

Fossil fuel combustion releases more than half of the greenhouse gases that threaten the earth's climate, including, most importantly, carbon dioxide. The United States is the largest contributor; with 5% of the global population, the United States accounts for 20% of the carbon emissions. Net U.S. carbon emissions are almost exclusively from fossil fuel combustion.[16]

An assessment of the scientific evidence by the Intergovernmental Panel on Climate Change (IPCC), which laid the groundwork for the international global warming treaty negotiations currently underway, predicted, based on climate model results, that the global mean temperature will increase at about 0.3 degree Centigrade per decade during the next century, a more rapid increase than seen over the past 10,000 years, and an average global mean sea-level rise of 6 cm per decade. The IPCC impacts assessment concluded that "increases in atmospheric concentrations of greenhouse gases may lead to irreversible change in the climate which could be detectable by the end of this century.[17]

The Environmental Protection Agency's 1989 draft report to Congress on policy options for stabilizing global climate concludes that a 50-80% worldwide reduction in anthropogenic (from human activities) emissions of carbon dioxide are necessary to stabilize atmospheric concentrations at current levels, along with reductions in emissions of the other greenhouse gases as well.[18] For the United States, and the world, to achieve such a reduction in carbon emissions would require a dramatic cut in fossil fuel consumption and a strategic shift to some combination of reduced energy demand and use of non-carbon-emitting alternative energy sources. The combined

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[15] (continued)

Warming." National Academy Press, Washington, D.C. [hereinafter cited as NAS Global Warming Report].

[16] OTA Global Warming Report, at P. 3.

[17] Intergovernmental Panel on Climate Change. 1990. "IPCC First Assessment Report: Overview," World Meteorological Organization/U.N. Environment Program, at Pp. 2,4.

[18] EPA Global Warming Policy Options, Executive Summary, at P. 15. This general conclusion is also suggested by Intergovernmental Panel on Climate Change. 1990. "Scientific Assessment of Climate Change, Summary and Report." Cambridge University Press, Cambridge, Massachusetts.

pressures of population and economic growth, under which carbon emissions could potentially increase steeply, along with current inefficient energy-use practices, would make a target of achieving and maintaining a 50% or greater reduction from current emissions levels even more challenging. Taking steps to develop and deploy more energy-efficient technologies will reduce emissions during a transition to nonfossil fuels. The principal current nonfossil alternatives include nuclear energy and solar and other renewable energy sources.[19]

The Office of Technology Assessment concludes in a 1991 report on steps to reduce greenhouse gases:

> We cannot yet predict the magnitude of climatic effects from greenhouse gas emissions with accuracy. But it is clear that the decision to limit emissions cannot await the time when the full impacts are evident. The lag time between emission of the gases and their full impact is on the order of decades to centuries; so too is the time needed to reverse any effects. Today's emissions thus commit the planet to changes well into the 21st century. And the lag times between identification of policy options, legislation of controls, and actual implementation can also be considerable. For example, the recent reauthorization of the Clean Air Act took 10 years; implementation of the Act will begin now and continue over the next 10 to 20 years.[20]

Based on a modeling analysis of several U.S. energy future scenarios, OTA projects that, under current trends and regulations, carbon emissions by 2015 will be close to 50% greater than today's level. On the other hand, emissions could be cut to 29% below 1987 levels in 2015, but only by implementing a "Tough" measures scenario to reduce fossil fuel demand, principally through energy-efficiency improvements and secondarily through fuel-switching. OTA concludes that "climate change can only be effectively addressed over the long-term with the development and worldwide use of better nonfossil energy sources."[21]

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[19] Biomass combustion produces emissions of carbon dioxide. However, if the biomass feedstock is managed on a sustainable basis, with harvesting offset by replanting and regrowth, a carbon cycle can be established that results in no net emissions.

[20] OTA Global Warming Report, at P. 3.

A 1991 report on "Policy Implications of Global Warming" by a National Academy of Sciences panel concluded that, while scientific understanding of global climate change is incomplete and fraught with uncertainties, the potential damage from uncontrolled global warming is so enormous that the United States should begin to take certain steps now to reduce greenhouse-gas emissions. The report concludes that "energy efficiency and conservation is a rich field for reducing greenhouse gas emissions," and recommends policies to enhance efficiency, including "sharply increasing the emphasis on efficiency and conservation in the federal research and development budget." To "make greenhouse warming a key factor in planning for our future energy supply mix," the Academy panel recommends that the United States "increase research and development on alternative energy supply technologies (e.g., solar), and design energy systems utilizing them in conjunction with other energy supply technologies to optimize economy and performance. (The report also calls for "developing and testing operationally a new generation of nuclear reactor technology that is designed to deal with safety, waste management, and public acceptability.")[22]

The Academy panel also recommends the study and gradual introduction of the "full social cost pricing" of energy, a policy that would, in effect, encourage the selection of efficiency and renewable energy options:

> On the basis of the principle that the polluter should pay, pricing of energy production and use should reflect the full costs of the associated environmental problems. The concept of full social cost pricing is a goal toward which to strive.

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[21] OTA Global Warming report, at Pp. 9,16.

[22] NAS Global Warming Report, at Pp. 73-74.

Including all social, environmental, and other costs in energy prices would provide consumers and producers with the appropriate information to decide about fuel mix, new investments, and research and development.[23]

The Budget Resolution recommends increases above the freeze level in FY 1992 R&D funding for conservation, solar, and alternative fuels, as programs that will enhance national energy security and reduce the likelihood of future energy emergencies. "The Committee also believes that new concerns with global climate change, and with the quality of the environment, bring further urgency to dealing with these issues.[24]

B. Energy Efficiency Research and Development

1. Reversing the Loss of Momentum on Energy Efficiency

From 1974 through 1980, Congress established several complementary programs, primarily at the Department of Energy, to implement energy saving measures in virtually every sector of societal activity. These programs were created primarily in response to national security and economic stability concerns. However, progress in the use of more efficient technologies has affected and is likely to continue to affect national interests in industrial competitiveness, electric power, and environmental quality. The Federal program in energy conservation grew rapidly in the 1970s, primarily as a domestic alternative to oil imports. However, program support waned in the 1980s as a result of the Reagan Administration's "free market" energy policy and generally declining energy prices.

Between FY 1979 and FY 1989, funding for DOE energy conservation R&D programs was cut by 70% in real terms. Since FY 1989 there has been a moderate reversal of the downward trend, with increased funding for conservation R&D programs in the buildings, industrial, and transportation sectors. The FY 1991 funding level has been restored to the level of about one-half of the funding for conservation R&D that was provided in the FY 1978 budget, in real terms.

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[23] NAS Global Warming Report, at P. 73.

[24] Budget Resolution, April 1991, at P. 48.

[Add comparison of U.S. energy efficiency as compared with efficiency of principal U.S. trading partners.]
[Add examples from Hearing testimony by Rosenfeld on the cost-effectiveness of key DOE conservation R&D programs.]
[Add references to ceramics, Metals Initiative, and municipal waste-to-energy technologies.]
[Add discussion of DOE FY 1992 budget request.]

2. Strengthening Energy Efficiency Programs

The Committee authorizes the Department FY 1992 R&D budget request of $247,515,000 for **Energy Conservation Programs**, with an increase of $79,385,000, for a total authorization of $326,900,000.

Buildings Sector:

The Committee authorizes the Department FY 1992 request of $38,937,000 for the Buildings Sector programs, with an increase of $29,063,000, for a total authorization of $68,000,000. For buildings sector conservation programs, the Committee authorizes increases as follows:

–For Buildings Sector Solar Technologies, $4,000,000 is added to expand research and development of space conditioning technologies, including solar cooling, and to expand the department's daylighting analysis and electrochromic window research.

–For Materials and Structures, $3,900,000 is added to expand research and development work on materials, windows and glazings, high-performance building envelope integration of solar energy for energy-efficient buildings, and moisture-control strategies.

–For Lighting and Appliances, $3,000,000 is added for expanded research and development, of which $1,000,000 is for investigation of a solid-state lighting source.

–For Heating and Cooling Equipment, $8,000,000 is added to expand research and development, of which $2,500,000 is for testing residential heat pumps in cooperation with the Gas Research Institute.

–For Indoor Air Quality, $1,500,000 is added for research.

–For Buildings System Research, $8,663,000 is added for expanded research, of which $2,500,000 is for a new initiative on Industrialized Housing. Of the additional monies provided for Buildings System research, DOE is directed to utilize the laboratories to establish a demonstration program with the Architect of the Capitol to demonstrate advanced cost-effective energy-efficient measures.

Industry Sector:

The Committee authorizes the Department FY 1992 budget request of $97,110,000 for **Industry Sector** programs, with an increase of $20,890,000, for a total authorization of $118,000,000. For industrial sector conservation programs, the Committee authorizes increases as follows:

–For Industrial Wastes, $2,890,000 is added, of which $1,000,000 is for research and development work on waste minimization at small and medium-sized firms.

–For Industrial Cogeneration, $4,000,000 is added to expand research and development work on ceramic parts in stationary gas turbines.

–For Electric Drives, $2,000,000 is added to increase the level of program effort.

–For Separations, $2,000,000 is added to expand research and development of alternative separations processes.

–For Bioprocessing, $1,000,000 is added to expand research and development of reaction engineering.

–For Enabling Materials, $4,500,000 is added to expand research and development of a continuous fiber ceramic composite material.

–For Improved Combustion Efficiency, $4,000,000 is added, which includes support for diesel engine research and for cooperative research with the Gas Research Institute.

–For Industry Sector Management, $500,000 is added to ensure appropriate staffing to manage expanded programs.

Transportation Sector:

The Committee authorizes the Department FY 1992 budget request of $104,668,000 for **Transportation Sector** programs, with an increase of $27,332,000, for a total authorization of $132,000,000. The Committee authorizes increases as follows:

–For Alternative Fuels Utilization, $5,000,000 is added for increased research and development, including engine optimization activities.

–For Materials Development, $5,000,000 is added, including support for expanded program emphasis on reducing the cost of producing ceramic components, and for tribology research.

–For Heat Engine Development, $6,000,000 is added, of which $4,000,000 is for light-duty engine development, and $2,000,000 is for heavy-duty engine development.

–For Electric and Hybrid Propulsion Development, $10,832,000 is added, of which $5,000,000 is for basic battery research and development, $3,832,000 is for fuel cell research and development, and $2,000,000 is for electric vehicle systems.

–For Transportation Sector Management, $500,000 is added to ensure appropriate staffing to manage an expanded program.

Utility Sector:

The Committee authorizes the Department FY 1992 budget request of $6,800,000 for **Utility Sector** programs, with an increase of $2,100,000, for a total authorization of $8,900,000. For Utility Sector energy conservation, the $2,100,000 is added for Integrated Resource Planning activities and research and development work on District Heating and Cooling. The Committee directs the Department to provide a report on the feasibility of cost-effective district heating and cooling opportunities by February 1, 1992.

C. Renewable Energy Research and Development

1. The Lagging U.S. Renewable Energy Effort

Despite the advantages of renewable energy technologies over fossil fuels in terms of their comparatively limited environmental impacts and the size of the renewable resource base, various Federal and State policies have served to reinforce a preference for burning fossil fuels. During the 1980s, a drop in energy prices, combined with lack of support from public policy, led Federal investment in alternative energy supply R&D to dwindle, tax credits for renewable energy investment to be eliminated, and much of the private sector investment in this area to be eliminated.

Federal R&D policy has placed renewable energy technologies at a significant disadvantage in competition with other sources of energy supply. Between FY 1979 and FY 1990, DOE's budget for renewable energy programs was cut 90% in real terms. During that same time period, renewable energy's share of total energy supply R&D funding was reduced from 20% to 4%, making it very difficult for these technologies to extend their range of development and application.[25]

A number of our trading partners are investing significantly greater shares of their energy research and development budgets in renewable energy technologies than is the United States. U.S. manufacturers of renewable energy systems have been losing ground to foreign competitors in a pattern reminiscent of the decline of the domestic consumer electronics industry in the 1970s. Germany and Japan, in particular, have made the development of technologies to support a growing world market for renewable energy use a national priority. For example, Germany spends 65% more, and Japan 40% more, on photovoltaics.[26] Seven European countries are spending as much or more on wind energy development.[27] Federal support for hydrogen energy is about $2 million, compared to $20 million per year in Japan and $50 million in Germany.[28]

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[25] Fred J. Sissine. 1990. "Renewable Energy: A New National Commitment?" CRS Issue Brief IB90110. Congressional Research Service, The Library of Congress, Washington, D.C. [hereinafter cited as CRS, "Renewable Energy"]

The world market for renewable energy technologies is growing, from $1 billion in 1986 to a projected $2 billion in 1991. We are rapidly losing our leadership position in supplying an increasingly diverse overseas market. U.S.-produced technologies, which dominated world markets for wind and photovoltaics in the early 1980s, now account for less than one-third of these markets.[29] The U.S. share of the non-U.S. world market for wind power turbines dropped from 27% in 1983 to 5% by 1987. The European Community directs $30 million to promoting photovoltaic/wind water pumping technology in its African Development programs alone, almost as much as was spent on the entire Federal R&D program for photovoltaics in 1990.[30]

While renewable energy technologies have made significant advances during the past decade in spite of this record of neglect, considerably more progress can be made with greater support from public policy, both to advance technology development and to expand domestic and international markets. The United States still maintains a technological lead in key renewable energy technologies. However,

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[26] Interlaboratory White Paper at P. G-3.

[27] Those countries are Denmark, Germany, Italy, The Netherlands, Spain, Sweden, and the United Kingdom. Interlaboratory White Paper at P. F-9.

[28] Ogden, Joan M. and Robert H. Williams. 1989. "Solar Hydrogen." World Resources Institute, Washington, D.C. at P. 93.

[29] CRS, "Renewable Energy," at P. 4.

[30] American Wind Energy Association and Solar Energy Industries Association, cited in Public Citizen, et al. 1991. "Recommendations for the U.S. department of Energy's Research and development Budget for Renewable Energy Technologies, FY1992-1994." Public Citizen, Washington, D.C. at P. 1.

> If the United States is to take advantage of our technical lead in solar technologies and the ultimate jobs, profits, and energy savings derived from our leadership, we must take advantage immediately of our competitive edge. Since our international competitors are outspending our government's R&D funding, we run the risk of being undercut and ultimately importing the very technologies in which we now lead. Such a loss of technical and competitive leadership would be a tragedy.[31]

The President's National Energy Strategy calls for a "continuing increase in research and development to reduce costs and improve the performance and efficiency of emerging technologies."[32] Specifically, the NES states the following objectives:

- increase funding for R&D related to renewable energy to reduce the costs of and increase industry confidence in, selecting solar, wind, biomass, and geothermal technologies to generate electric power;
- increase funding for R&D on waste-to-energy systems as a part of a comprehensive waste management program to support the conversion of municipal solid waste to energy;
- increase funding for R&D on new biomass feedstocks and conversion technologies to develop economical liquid fuels from biomass as alternatives to petroleum based fuels; and
- increase funding for R&D on innovative building materials and designs to use renewable energy for direct heating, cooling, and lighting in buildings.[33]

Unfortunately, despite the rhetoric of the NES, the Administration's FY 1992 budget request for renewable energy programs falls short, representing only a 4%

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[31] 1991 Hearing on Energy Conservation, testimony of Sklar, Solar Energy Industries Association.

[32] NES, at P. 121.

[33] NES, at P. 119.

increase over the FY 1991 level, from $157.7 million to $164.1 million. This level of funding is not sufficient to support and strengthen the programs needed as part of a rational national energy policy to ensure that an increasing proportion of our future energy supply is produced from renewable sources.

In addition to the level of funding, the direction of research and development is crucial. In addition to advancing basic science, R&D policy should promote the transfer of research results to the marketplace. Most renewable technologies need greater collaboration between government and industry to foster market development. A key element of R&D policy should be a more aggressive effort through cooperative ventures to develop renewable energy technologies that have been proven in the laboratory but have not yet been demonstrated on a large commercial scale. This aspect of R&D policy was shortchanged for a decade.

> Rather than direct R&D funds to projects that would make renewable energy technologies more attractive to industry, the Reagan Administration supported only basic scientific research. Little effort was made to transfer the knowledge to industry, to commercialize new technologies through joint ventures with industry, or to gear new research to the practical needs of industry in developing commercial products. The Bush Administration has indicated an intention to focus R&D efforts on commercialization. Special effort should be made to achieve this goal, yet the lack of increasied funding for renewable energy technologies would make it difficult to realize.[34]

2. Strengthening Solar and Renewable Energy Programs

The Committee authorizes the Department of Energy FY 1992 budget request of $197,839,000 for **Solar and Renewable Energy Programs**, with an increase of

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[34] Public Citizen, et al., at P. 7.

$81,061,000, for a total program authorization of $278,900,000.

Solar Energy:

The Committee authorizes the Department FY 1992 budget request of $139,666,000 for the **Solar Energy Program**, with an increase of $73,731,000, for a total program authorization of $213,397,000. In the Solar Energy Program, the Committee authorizes increases as follows:

--For Solar Building Technology Research, $2,026,000 is added to the program to support solar heating and cooling active systems research on improved efficiency of components, glazings, controls, and performance characterization.

--For Photovoltaic Systems, $26,000,000 is added to the program. The additional authorization includes $1,000,000 for fundamental research; $4,000,000 to expand research on advanced materials; and $21,000,000 for collector research and systems development, including expanded participation in the PV Manufacturers Initiative to reduce manufacturing costs of PV systems.

--For Solar Thermal Energy Systems, $25,449,000 is added to the program. The additional authorization includes $7,000,000 for collector and energy conversion research; $15,449,000 for systems development to accelerate testing and commercialization of solar dish/engine technologies, and for a cost-shared project to upgrade Solar One to accelerate the development of central receiver technology; and $3,000,000 to accelerate research on solar waste detoxification technology.

--For Biofuels Energy Systems, $10,200,000 is added to the program. The additional authorization includes $1,000,000 to accelerate the near-term development of biomass-powered systems in the utility sector, and $9,200,000 to expand biomass feedstock development and research and development of biochemical and thermochemical conversion technologies.

--For Wind Energy Systems, $9,056,000 is added to the program. The additional authorization includes $2,056,000 to expand investigation of aerodynamics and structural dynamics, and $7,000,000 for advanced systems, including development of an advanced wind turbine for the near-term.

--For Solar Program Direction, $1,000,000 is added to ensure appropriate staff levels to manage an expanded research and development program.

Geothermal Energy:

The Committee authorizes the Department FY 1992 budget request of $20,170,000 for **Geothermal Energy**, with an increase of $3,830,000 to support an expanded research and development effort, for a total program authorization of $24,000,000.

Electric Energy Systems:

The Committee authorizes the Department FY 1992 budget request of $30,757,000 for **Electric Energy Systems**, with an increase of $1,500,000, for a total authorization of $32,257,000.

The Committee is concerned that some recent scientific evidence indicates potentially adverse human health effects as a result of exposure to electric and magnetic radiation. Such nonionizing radiation emanates from devices which produce, use, or carry electricity. Recent research has shown that weak electric and magnetic fields (EMF) can produce reactions affecting membrane-cell interactions in ways that are compatible with early carcinogenesis. Several epidemiological studies have also linked EMF exposure with cancer. Other biological mechanisms which are affected by EMF include altered melatonin levels, increased rate of DNA formation and cell division, and altered flux of calcium in cells. Further research is needed to reduce scientific uncertainties regarding the health effects of exposure to EMF, with particular attention to the 60 hertz frequency. The Committee bill provides $6,500,000 for research to be conducted by DOE in FY 1992. Of this amount, $1,500,000 is provided for a grant to the private sector for the development of a national research program to assess the effects of exposure to electromagnetic field radiation. The federal component of this research program will be co-funded by EPA and, at a minimum, the Federal contribution will be matched by the private sector. It is the Committee's understanding that a coalition of utilities and electrical equipment manufacturers have expressed interest in funding such a research effort. This research program should be administered by an independent, nationally recognized research institute in order to eliminate the perception that the outcome of any study may be biased.

The Committee authorizes the Department FY 1992 budget request of $7,246,000 for the **Energy Storage Systems Program**, with an increase of $2,000,000 to expand hydrogen research, including production, storage system development, and end-use technologies, for a total authorization of $9,246,000.

D. ENVIRONMENT, SAFETY, AND HEALTH PROGRAM

The Administration Fiscal Year 1992 budget request for the Environment, Safety, and Health (ES&H) program is $142,309,000, a 48 percent increase over the Fiscal Year 1991 appropriated level. However, the actual program increase is only 7.7 percent because funds were reprogrammed ($35,825,000) during Fiscal Year 1991 for epidemiologic research from other program areas in the Energy Department to the ES&H program.[35] The Committee supports the President's request for this program for Fiscal Year 1992, and projects a 10 percent increase for Fiscal year 1993, to $156,540,000.

The Committee continues to be gravely concerned about the environment, safety, and health aspects of DOE's facilities, especially those that comprise the nuclear weapons complex. A recent report by the Office of Technology Assessment (OTA), Complex Cleanup, concludes that there is extensive contamination of soil, sediments, surface water, and groundwater throughout DOE facilities.[36] OTA also found that cleanup efforts are characterized by a lack of ready technical solutions, reliable data, and qualified personnel and infrastructure; by inadequate efforts to assess possible health effects for people living in communities near DOE facilities; and by public distrust of DOE.

The Environmental Restoration and Waste Management (ERWM) program, under which the facility cleanup activities are now being carried out, is organizationally separate from the ES&H Office. It is funded at a level over $4 billion, primarily through Atomic Energy Defense Activities. However, the ES&H Office has the general responsibility for overseeing the environment, safety, and health aspects of all DOE operations, including the cleanup of DOE facilities. Testimony received during a recent hearing of the Subcommittee on Environment raises concerns that the ERWM program needs the type of external oversight that the ES&H program could provide, but that the ES&H Office is generally ill-equipped to handle the rapidly increasing and difficult oversight responsibilities that this program will require.[37] For example, many of the ES&H staff have recently moved to the Office of Quality Assurance/Quality Control within the ERWM program, leaving a staff gap in the ES&H Office.[38] The Committee directs the ES&H Office report to the Subcommittee on Environment by October 1, 1991 on its efforts to ensure that the ERWM program is executed in a manner that is protective of human health and the environment, including efforts to protect cleanup worker health and safety.

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[35] The consolidation of all epidemiologic research into one program area was begun during FY 1991 in response to the recommendations of a DOE advisory panel, the Secretarial Panel for the Evaluation of Epidemiologic Research Activities.

[36] Office of Technology Assessment, 1991. Complex Cleanup: The Environmental Legacy of Nuclear Weapons Production, report number OTA-O-484, Washington, D.C. 20

The Committee is also concerned with the poor safety-related conditions at DOE facilities. A recent safety evaluation conducted by the Occupational Safety and Health Administration (OSHA) revealed major program deficiencies and concluded that "DOE remains a mission-directed, production-oriented organization in which pressures to get the job done often overrule safety and health concerns."[39] The Committee urges the ES&H Office to correct as expeditiously as possible the safety deficiencies found by OSHA.

The Committee commends the Department for its efforts to consolidate all of the epidemiologic research under the ES&H program, and for signing a Memorandum of Understanding (MOU) with the Department of Health and Human Services (DHHS) to coordinate health research of personnel and residents near facilities. The Committee is concerned, however, that under the MOU, DOE remains responsible for collecting, storing, and releasing worker and community health data, a situation that could lead to insufficient data transferred to DHHS. The Committee urges DOE to release to DHHS all relevant epidemiological data in an expeditious manner. DOE's proposed system for dissemination of health data to DHHS and private researchers, the Comprehensive Epidemiologic Data Resource (CEDR), is behind schedule and has been critized for not going far enough to provide broad data access to independent researchers.[40] The Committee urges the Department to make data available to researchers through the CEDR to the maximum extent practicable.

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[37] Hearings on the Fiscal Year 1992 Budget Request for the Department of Energy's Environment, Safety, and Health program, before the Subcommittee on Environment of the Committee on Science, Space, and Technology, U.S. House of Representatives (102nd Congress, 1st Sess.), March 7, 1991, [hereinafter referred to as March 7 Hearings], testimony of James D. Werner and Dan W. Reicher of the Natural Resources Defense Council, Peter Johnson of the Office of Technology Assessment, and Victor Rezendes of the General Accounting Office.

[38] March 7 Hearings, supra, written testimony of James D. Werner at p.9.

[39] U.S. Department of Labor Occupational Safety and Health Administration. December, 1990. "Evaluation of the U.S. Department of Energy's Occupational Safety and Health Program for its Government-Owned Contractor-Operated Facilities," page i.

E. LIQUEFIED GASEOUS FUELS SPILL TEST FACILITY

This program supports research on the behavior of chemicals in the environment following a spill or other environmental release. Tests conducted at this remote facility are designed to improve understanding of dispersion patterns, combustion characteristics, and environmental effects of chemicals released to the environment, and to evaluate atmospheric dispersion models. Information gained is used to develop mitigation and cleanup techniques and emergency planning guidelines.

The Fiscal Year 1992 budget request for this facility is $1,115,000, a 3 percent increase over the Fiscal Year 1991 appropriated level of $1,079,000. As has been true for the past several years, these funds are being requested by DOE only to maintain operations of the Facility, not to conduct research at the Facility. The Committee recognizes that this program represents to a large extent the federal research capabilities in this area. Therefore, the Committee recommends that this activity be funded at $2,115,000 for Fiscal Year 1992, a $1 million increase (190 percent) over the requested level, to conduct research jointly with the Environmental Protection Agency authorized under the recent amendments to the Clean Air Act.[41] This provision requires DOE to work with the Administrator of the Environmental Protection Agency to develop a list of chemicals and a schedule for field testing at the Facility, with the highest priority given to those chemicals that would present the greatest potential risk to human health as a result of an accidental release.

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[40] March 7 Hearing, supra, written testimony of David Lewis of Physicians for Social Responsibility at p.3.

F. BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM

The Fiscal Year 1992 budget request for the Biological and Environmental Research (BER) program is $312,560,000. Of the many various biological research areas under this program, the main program areas to receive the largest increases in the President's request were general life sciences (18 percent) and the carbon dioxide research program (14 percent). The human genome project, under general life sciences, is to receive a 24 percent increase over the Fiscal Year 1991 level.

The Committee has authorized $311,560,000 for this program to offset the increase in environmental research activities to be performed at the Liquefied Gaseous Fuels Spill Test Facility. The Committee directs the DOE to determine the optimum strategy for achieving this reduction.

A hearing of the Subcommittee on Environment focused on two overall management aspects of the BER program: scientific peer review, and the process used to set priorities for initiating or continuing ongoing research programs.[42] Hearing testimony raised questions concerning the adequacy of scientific peer review afforded to ongoing programs in BER, and of the process in place for setting research priorities.

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[41] Clean Air Act Amendments, P.L. 101-549, section 901 (f).

[42] Hearings on the Fiscal Year 1992 Budget Request for the Department of Energy's Biological and Environmental Research program, before the Subcommittee on Environment of the Committee on Science, Space, and Technology, U.S. House of Representatives (102nd Congress, 1st Sess.), March 21, 1991, [hereinafter referred to as March 21 Hearings].

No comprehensive assessment of DOE's procedures for setting research priorities and conducting peer review of its research programs has yet been undertaken. The Subcommittee has requested that the General Accounting Office conduct a study of the adequacy of peer review and an evaluation of the priority-setting processes in place for this program.

The Committee shares the concerns expressed by the scientific community, the Department of Energy, and some Members of Congress that the growing number of congressionally mandated projects that are not peer reviewed are damaging to long-term basic science. A total of $85.6 million for 11 congressionally-directed construction projects was included in the Fiscal Year 1991 Appropriations Act for the BER program. DOE was forced to pay for these projects with funds which would otherwise have supported research.[43]

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[43] March 21 Hearings, supra, written testimony of Dr. James Decker to supplement transcript at p. 24.

The **Chairman**. You have heard the motion. All those in favor of the motion, signify by saying aye.

[Chorus of ayes.]

The **Chairman**. Opposed, no.

[No response.]

The **Chairman**. The ayes have it, and the bill is open for discussion at any point.

Do any additional members care to make any comments with regard to the bill before we entertain amendments?

[No response.]

The **Chairman**. If not, the bill is open for amendments at any point, and the Chair would like to make a statement.

The Chair offers an amendment in the nature of a substitute and asks unanimous consent that the text of the substitute be considered as original text for the purpose of markup.

The substitute I'm offering today combines the bills reported by both the Energy Subcommittee and the Environment Subcommittee and makes a number of reductions in funding reported by the subcommittees. The reductions were required in order to keep the total funding authorized by the committee for agencies under its jurisdiction from exceeding the President's budget request.

The substitute retains the programs and fundings reported by both subcommittees, with the following exceptions: funding for the Fast Flux Test Facility will come from the restoration and waste management account, where it was located last year, rather than from the nuclear R&D account; the levels of increased funding proposed for renewables, for AVLIS, and for conservation have been reduced from those reported, although all will enjoy substantial increases over 1991; and the supporting research and technology programs have been reduced by $3.5 million. Funding for the space exploration initiative has been increased by $10 million, as well as the SP100 Space Reactor Program, and I want to commend both Mr. Stallings and Mr. Walker for their efforts to increase funding for these programs. While I don't think either one of the gentlemen are completely satisfied, we will continue to discuss this matter with them with the possibility of entertaining an additional amendment on the floor when we get to that point.

While we could not meet everyone's desire in this substitute and, given the spread of political viewpoints on this committee, could not have done so even with an unlimited budget, we believe the substitute reflects a balanced, progressive program for enhancing our energy security, assuring economic growth and protecting the environment. I'm sure that the amendment I'm offering is an excellent amendment, in other words.

[The amendment proposed by Mr. Brown follows:]

BROWCA030

H.R. 2399

AMENDMENT IN THE NATURE OF A SUBSTITUTE
OFFERED BY MR. BROWN

Strike all after the enacting clause and insert in lieu thereof the following:

SECTION 1. SHORT TITLE.

This Act may be cited as the ``Energy Technology Research and Development Authorization Act of 1991''.

SEC. 2. FINDINGS.

The Congress finds that--

(1) the development of new energy technologies is a necessary step in reducing oil imports and providing for our Nation's energy needs in the 21st century;

(2) the development of efficient, economic, safe, and environmentally acceptable energy technologies is a necessary part of an effective National Energy Strategy;

(3) technologies to improve energy efficiency and utilize renewable energy resources offer significant opportunities to meet energy and environmental goals;

(4) technological advances in the recovery and use of our fossil fuel resources will provide time for an orderly transition to other energy sources while at the same time reducing our vulnerability to supply

disruptions, price escalations, and the environmental side effects of fossil fuel use; and

(5) technology development occurs over a time span that is often measured in years or even decades, therefore, commitments to new energy technology development must be consistent with those time requirements and cannot be made on a year-to-year basis.

SEC. 3. DEFINITIONS.

For purposes of this Act--

(1) the term ``major construction project'' means a project whose construction costs are estimated to exceed $100,000,000 over the life of the project;

(2) the term ``Secretary'' means the Secretary of Energy; and

(3) the term ``substantial construction project'' means a project whose construction costs are estimated to exceed $10,000,000, but not to exceed $100,000,000, over the life of the project;

SEC. 4. AUTHORIZATION OF APPROPRIATIONS.

(a) SUPPORTING RESEARCH AND TECHNICAL ANALYSIS.--There are authorized to be appropriated to the Secretary, for Supporting Research and Technical Analysis, the following amounts:

(1) Basic Energy Sciences Program--

(A) $714,700,000 for fiscal year 1992, of which

$6,300,000 shall be for completion of construction of the Advanced Light Source and $90,400,000 shall be for construction of the Advanced Photon Source;

(B) $836,500,000 for operating, capital equipment, and construction for fiscal year 1993, of which $437,600,000 shall be for research activities, $196,000,000 shall be for the operation of user facilities, $112,500,000 shall be for construction of the Advanced Photon Source, and $38,900,000 shall be for construction of the Advanced Neutron Source;

(C) $93,000,000 for fiscal year 1994 shall be for construction of the Advanced Photon Source; and

(D) $45,000,000 for fiscal year 1995 shall be for completion of the construction of the Advanced Photon Source;

(2) Energy Research Analysis Program, $4,000,000 for fiscal year 1992, and $4,200,000 for fiscal year 1993;

(3) Multiprogram Energy Laboratories Facilities Support program, $23,900,000 for fiscal year 1992, and $24,900,000 for fiscal year 1993;

(4) University and Science Education, $57,500,000 for fiscal year 1992, and $72,900,000 for fiscal year 1993; and

(5) Advisory and Oversight Program Direction and Policy Management for Energy Research activities,

$10,100,000 for fiscal year 1992, and $10,500,000 for fiscal year 1993.

Notwithstanding paragraphs (1) through (5), the total amount authorized to be appropriated under this subsection shall not exceed $806,700,000.

(b) NUCLEAR ENERGY.--There are authorized to be appropriated to the Secretary, for Nuclear Energy, the following amounts:

(1) Nuclear Energy Research and Development Program, $332,100,000 for fiscal year 1992, and $351,000,000 for fiscal year 1993, including--

(A) Certification of Light Water Reactor Designs, $44,500,000, for fiscal year 1992, of which $2,000,000 shall be for first-of-a-kind engineering for initiating the first standardized commercial nuclear power plant, and $62,500,000 for fiscal year 1993, of which $20,000,000 shall be for first-of-a-kind engineering for initiating the first standardized commercial nuclear power plant;

(B) Advanced Reactor Research and Development, $60,500,000 for fiscal year 1992, and $73,000,000 for fiscal year 1993;

(C) Space Reactor Power Systems, $46,000,000 for fiscal year 1992, and $46,500,000 for fiscal year 1993;

(D) Advanced Radioisotope Power, $56,000,000 for fiscal year 1992, and $58,000,000 for fiscal year 1993;

(E) Space Exploration Initiative, $15,000,000 for fiscal year 1992, and $15,000,000 for fiscal year 1993;

(F) Facilities Support, including operations, capital equipment, and general plant construction, $99,800,000 for fiscal year 1992, and $99,800,000 for fiscal year 1993; and

(G) Program Direction, Nuclear Energy, $10,200,000 for fiscal year 1992, and $16,200,000 for fiscal year 1993; and

(2) For developing and conducting an integrated research and development program to explore new technologies for reducing, treating, transmuting, separating, recycling, storing, or otherwise mitigating hazards associated with high level radioactive waste and spent fuel from nuclear reactors, $8,000,000 for fiscal year 1992, and $8,320,000 for fiscal year 1993.

(c) FUSION ENERGY RESEARCH AND DEVELOPMENT.--There are authorized to be appropriated to the Secretary, for Fusion Energy Research and Development, the following amounts:

(1) Magnetic Fusion Energy Research, including operating activities, program direction, capital

equipment, and construction activity--

(A) $328,900,000 for fiscal year 1992, of which--

(i) $30,000,000 shall be for preconstruction activities of the Burning Plasma Experiment facility; and

(ii) $41,800,000 shall be for the Engineering Design Activity of the International Thermonuclear Engineering Reactor; and

(B) $387,000,000 for fiscal year 1993, of which $35,400,000 shall be for construction of the Burning Plasma Experiment facility; and

(2) Inertial Confinement Fusion Program, $8,200,000 for fiscal year 1992, and $14,000,000 for fiscal year 1993.

(d) ATOMIC VAPOR LASER ISOTOPE SEPARATION PROGRAM.--There are authorized to be appropriated to the Secretary, for the Atomic Vapor Laser Isotope Separation Program, the following amounts:

(1) $218,600,000 for fiscal year 1992, of which--

(A) $20,000,000 shall be for procurement of a commercial deployment contractor and a predeployment assessment of the demonstration of Atomic Vapor Laser Isotope Separation technology and the preparation of a report to the Congress, to be submitted within 90 days after completion of such demonstration, on the economic market, financing, and risk assessment for commercial deployment of such technology;

(B) $6,100,000 shall be for capital equipment; and

(C) $3,200,000 shall be for construction; and

(2) $225,800,000 for fiscal year 1993.

(e) ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT PROGRAM.--There are authorized to be appropriated to the Secretary, for corrective activities, environmental restoration, waste management, and related technology development for civilian programs and activities of the Department of Energy, $523,500,000 for fiscal year 1992, of which $79,000,000 shall be for the Fast Flux Test Facility, and $594,200,000 for fiscal year 1993, of which $69,000,000 shall be for the Fast Flux Test Facility.

(f) FOSSIL ENERGY.--There are authorized to be appropriated to the Secretary, for Fossil Energy, the following amounts:

(1) $471,000,000 for fiscal year 1992, of which--

(A) $206,000,000 shall be for Basic and Supporting Research, including Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification, and Surface Coal Gasification;

(B) $89,000,000 shall be for Advanced Technology Development, including $48,000,000 for Fuel Cells, and $41,000,000 for Magnetohydrodynamics;

(C) $70,000,000 shall be for Petroleum;

(D) $23,000,000 shall be for Natural Gas;

(E) $6,000,000 shall be for Cooperative Research and Development; and

(F) $77,000,000 shall be for Supporting Activities, including Program Direction and Management Support, Environmental Restoration, and Plant and Capital Equipment; and

(2) $507,000,000 for fiscal year 1993, of which--

(A) $214,000,000 shall be for Basic and Supporting Research, including Control Technology and Coal Preparation, Advanced Research and Technology Development, Coal Liquefaction, Combustion Systems, Heat Engines, Underground Coal Gasification, and Surface Coal Gasification;

(B) $88,000,000 shall be for Advanced Technology Development, including $60,000,000 for Fuel Cells, and $28,000,000 for Magnetohydrodynamics;

(C) $90,000,000 shall be for Petroleum;

(D) $26,000,000 shall be for Natural Gas;

(E) $7,000,000 shall be for Cooperative Research and Development; and

(F) $82,000,000 shall be for Supporting Activities, including Program Direction and Management Support, Environmental Restoration, and Plant and Capital Equipment.

(g) SOLAR AND RENEWABLE ENERGY.--There are authorized to be appropriated to the Secretary, for solar and renewable energy programs, $278,900,000 for fiscal year 1992, and $335,176,000 for fiscal year 1993. Of the amounts authorized for fiscal year 1992--

(1) $213,397,000 shall be for Solar Energy, including--

(A) $3,026,000 for Solar Building Technology Research;

(B) $76,800,000 for Photovoltaic Systems, of which--

(i) $8,336,000 shall be for Fundamental Research;

(ii) $27,064,000 shall be for Advanced Materials and Devices;

(iii) $39,900,000 shall be for Collector Research and Systems Development; and

(iv) $1,500,000 shall be for Capital Equipment;

(C) $45,468,000 for Solar Thermal Energy Systems, of which--

(i) $14,900,000 shall be for Collection and Conversion;

(ii) $19,449,000 shall be for Systems Development;

(iii) $100,000 shall be for Capital Equipment; and

(iv) $11,019,000 shall be for Industry Sector Solar Industrial Applications;

(D) $47,000,000 for Biofuels Energy Systems, of which--

(i) $5,000,000 shall be for Utility Sector Biomass Systems;

(ii) $1,400,000 shall be for Industry Sector Municipal Solid Wastes;

(iii) $6,000,000 shall be for Transportation Sector Feedstock Development;

(iv) $24,200,000 shall be for Transportation Sector Biochemical Conversion;

(v) $4,200,000 shall be for Transportation Sector Thermochemical Conversion;

(vi) $4,200,000 shall be for Transportation Sector Capital Equipment; and

(vii) $2,000,000 shall be for the Regional Biomass Program;

(E) $23,000,000 for Wind Energy Systems, of

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which--

(i) $7,300,000 shall be for Aerodynamics and Structural Dynamics Research;

(ii) $15,500,000 shall be for Advanced Systems and Supporting Research; and

(iii) $200,000 shall be for Capital Equipment;

(F) $936,000 for Solar Program Support;

(G) $11,505,000 for the Solar Energy Research Institute; and

(H) $5,662,000 for Program Direction;

(2) $24,000,000 shall be for Geothermal Energy;

(3) $32,257,000 shall be for Electric Energy Systems, including $6,500,000 for Electric Field Effects, of which $1,500,000 shall be for the establishment of a grant to the private sector for the assessment of the effects of exposure to electromagnetic fields; and

(4) $9,246,000 shall be for Energy Storage Systems, including $4,600,000 for Hydrogen Research.

(h) ENERGY CONSERVATION.--There are authorized to be appropriated to the Secretary, for energy conservation programs, $326,900,000 for fiscal year 1992, and $392,150,000 for fiscal year 1993. Of the amounts authorized for fiscal year 1992--

(1) $68,000,000 shall be for Building Sector,

including--

(A) $5,872,000 for Solar Technologies;

(B) $9,140,000 for Materials and Structures;

(C) $7,450,000 for Lighting and Appliances, of which $1,000,000 shall be for a lighting diode initiative;

(D) $18,680,000 for Heating and Cooling Equipment, of which $2,500,000 shall be for testing new residential heat pumps in cooperation with the Gas Research Institute;

(E) $3,149,000 for Indoor Air Quality;

(F) $16,344,000 for Building Systems Research, of which $2,500,000 shall be for a new initiative on industrialized housing; and

(G) $7,365,000 for Management;

(2) $118,000,000 shall be for Industry Sector, including--

(A) $19,590,000 for Industrial Wastes, of which $1,000,000 shall be for a new initiative to conduct research and development for waste minimization at small- and medium-sized firms;

(B) $6,300,000 for Municipal Solid Wastes;

(C) $7,264,000 for Cogeneration;

(D) $2,500,000 for Electric Drives;

(E) $20,871,000 for Materials Processing, of which $17,968,000 shall be for the Metals Initiative as provided in subsection (1) of this section;

(F) $6,947,000 for Separations;

(G) $2,410,000 for Sensors and Controls;

(H) $6,000,000 for Bioprocessing;

(I) $19,911,000 for Enabling Materials;

(J) $10,872,000 for Improved Combustion Efficiency, including diesel engine research and a cooperative initiative with the Gas Research Institute;

(K) $6,860,000 for Process Heating and Cooling; and

(L) $8,475,000 for Management;

(3) $132,000,000 shall be for Transportation Sector, including--

(A) $21,000,000 for Alternative Fuels Utilization, of which $8,000,000 shall be for engine optimization;

(B) $28,800,000 for Materials Development, of which $20,000,000 shall be for Ceramic Technology;

(C) $22,513,000 for Heat Engine Development, of which--

(i) $15,513,000 shall be for Light Duty Engine Development; and

(ii) $7,000,000 shall be for Heavy Duty

Engine Development;

(D) $52,432,000 for Electric and Hybrid Propulsion Development, of which--

(i) $27,000,000 shall be for an industry consortium for battery research and development;

(ii) $5,000,000 shall be for basic research;

(iii) $13,332,000 shall be for fuel cells, including $2,832,000 for a zero emission hydrogen vehicle; and

(iv) $7,100,000 shall be for systems development; and

(E) $7,255,000 for Management; and

(4) $8,900,000 shall be for Utility Sector.

(i) BIOLOGICAL AND ENVIRONMENTAL RESEARCH PROGRAM.--There are authorized to be appropriated to the Secretary, for biological and environmental research, $311,560,000 for fiscal year 1992, and $330,500,000 for fiscal year 1993.

(j) ENVIRONMENT, SAFETY, AND HEALTH PROGRAM.--There are authorized to be appropriated to the Secretary, for the environment, safety, and health program, $142,309,000 for fiscal year 1992, and $156,540,000 for fiscal year 1993. Of the amounts authorized for fiscal year 1992--

(1) $10,920,000 shall be for Special Projects;

(2) $18,240,000 shall be for Environment;

(3) $24,620,000 shall be for Safety and Quality

Assurance;

(4) $62,239,000 shall be for Health;

(5) $4,100,000 shall be for Planning;

(6) $20,590,000 shall be for Program Direction; and

(7) $1,600,000 shall be for Capital Equipment.

(k) LIQUEFIED GASEOUS FUELS SPILL TEST FACILITY.--There are authorized to be appropriated to the Secretary, for the Liquefied Gaseous Fuels Spill Test Facility, $2,115,000 for fiscal year 1992, and $3,000,000 for fiscal year 1993.

(l) STEEL AND ALUMINUM RESEARCH.--The Steel and Aluminum Energy Conservation and Technology Competitiveness Act of 1988 is amended--

(1) in section 4(b)(5), by striking ``Industrial Programs'' and inserting in lieu thereof ``Industrial Technologies'';

(2) in section 8, by inserting at the end the following new sentence: ``The report submitted at the close of fiscal year 1993 shall also contain a complete summary of activities under the management plan and the research plan from the first year of their operation, along with an analysis of the extent to which they have succeeded in accomplishing the purposes of this Act.'';

(3) in section 9(a)(1), by striking ``and $25,000,000 for fiscal year 1991'' and inserting in lieu thereof ``$25,000,000 for fiscal year 1991, $17,968,000 for

fiscal year 1992, and $20,700,000 for fiscal year 1993'';

(4) in section 9(b), by striking ``and 1991'' and inserting in lieu thereof ``1991, 1992, and 1993''; and

(5) in section 11(a), by striking ``or fiscal year 1991'' both places it appears and inserting in lieu thereof ``fiscal year 1991, fiscal year 1992, or fiscal year 1993''.

(m) REPEALS.--(1) The Renewable Energy and Energy Efficiency Technology Competitiveness Act of 1989 is amended--

(A) in section 4(c)(1)(C), by striking ``Program;'' and inserting in lieu thereof ``Program.'';

(B) by striking section 4(c)(2) and (3);

(C) in section 5(1)(B), by striking ``program;'' and inserting in lieu thereof ``program.''; and

(D) by striking section 5(2) and (3).

(2) Section 109 of the Spark M. Matsunaga Hydrogen Research, Development, and Demonstration Act of 1990 is amended by striking ``other Acts)'' and all that follows through ``$10,000,000'' and inserting in lieu thereof ``other Acts) $10,000,000''.

SEC. 5. MAJOR CONSTRUCTION POLICY.

(a) STATEMENT OF POLICY.--(1) It shall be the policy of the United States, with respect to substantial construction projects of the Department of Energy in civilian energy research and development areas, to authorize appropriations for the life of such substantial construction projects when the projects are initially authorized.

(2) It shall be the policy of the United States, with respect to major construction projects of the Department of Energy in civilian energy research and development areas, to authorize appropriations for the life of such major construction projects when the preliminary design phase is completed and appropriate information is provided to the Congress with respect to anticipated costs and schedules.

(b) REPORT TO CONGRESS.--The Secretary shall, after completion of the preliminary design phase of a major construction project, submit to the Congress a report containing--

(1) an estimate of the total cost of construction of the facility;

(2) an estimate of the time required to complete construction;

(3) an estimate of the annual operating costs of the facility;

(4) the intended useful operating life of the facility; and

(5) an identification of any existing facilities to be closed as a result of the operation of the facility.

SEC. 6. ADVANCED NEUTRON SOURCE AND BURNING PLASMA EXPERIMENT

MAJOR CONSTRUCTION REPORTS.

The Secretary shall, within 120 days after the date of completion of the preliminary design phase of the Advanced Neutron Source major construction project, and of the Burning Plasma Experiment major construction project, provide the Congress with information on the anticipated cost and schedule with respect to each such project, to enable the Congress to consider authorization of each such project in its entirety as a major construction project.

SEC. 7. ATOMIC VAPOR LASER ISOTOPE SEPARATION.

(a) DEPLOYMENT CONTRACTOR.--The Secretary shall proceed expeditiously to procure a deployment contractor for the commercialization of the Atomic Vapor Laser Isotope Separation technology.

(b) IDENTIFICATION OF ALTERNATIVE APPLICATIONS.--The Secretary shall authorize the University of California and Martin Marietta Energy Systems, Inc. to enter into cooperative research and development agreements with private sector entities to identify and develop non-uranium enrichment applications of the Atomic Vapor Laser Isotope Separation technologies.

SEC. 8. STANDARDIZED COMMERCIAL NUCLEAR POWER PLANT.

(a) AWARD OF CONTRACT.--The Secretary shall award a contract for further design and engineering with respect to a standardized commercial nuclear power plant design that has been certified by the Nuclear Regulatory Commission.

(b) SELECTION CRITERIA.--The Secretary shall award the contract under subsection (a) to an entity that certifies to the satisfaction of the Secretary that--

(1) the plant will be constructed in the United States;

(2) at least 75 percent of all design, engineering, manufacture, and construction activities in connection with the plant shall be performed in the United States;

(3) the entity is a bona fide entity normally engaged in the design, engineering, manufacture, and construction of nuclear reactors;

(4) the entity has entered into a binding agreement for construction of a nuclear power plant with a utility or private entity whose primary purpose is the production of electrical power for public consumption; and

(5) the entity has the financial resources necessary, and fully intends, to pursue the design, engineering, manufacture, and construction of a full-scale nuclear power plant of at least 600 MWe in size through completion of construction and into operation.

(c) FUNDING.--The project described in this section shall receive at least 50 percent of its funding from non-Federal sources. Federal funding for such project shall not exceed $20,000,000 for each fiscal year, and the total of Federal funding over the course of such project shall not exceed $60,000,000.

SEC. 9. HISTORICALLY BLACK COLLEGES AND UNIVERSITIES.

The Secretary shall, within 6 months after the date of enactment of this Act, submit to the Congress a report outlining plans for increasing the participation of historically black colleges and universities in the Basic Energy Science programs of the Department of Energy.

SEC. 10. RESEARCH REACTOR USER COMPLEX.

(a) Purpose.--The purpose of this section is to establish the Fast Flux Test Facility as a multi-mission center for the purpose of conducting research and development on isotopes and energy, to be operated by the Department of Energy in partnership with international and domestic user organizations.

(b) Establisment.--Not later than 90 days after the date of enactment of this Act, the Secretary shall establish a research, development, and production center at the Hanford Reservation in Richland, Washington, to be known as the ``Research Reactor User Complex'' (hereafter in this section referred to as ~~the ``RRC''~~).

(c) Agreements; Authorized Uses.--In establishing the RRC, the Secretary shall provide that the Department of Energy, and any contractors under contract with the Department of Energy to operate the RRC, may enter into agreements with non-Federal entities (including foreign governments and foreign entities) or a consortium of such entities to use the RRC for any of the following purposes:

(1) The production of industrial and medical isotopes for use or sale, or both, by the non-Federal entities who have entered into the agreement.

(2) Irradiation services to support research or commercial objectives, or both.

(3) The production of steam to be used or sold, or both, by the non-Federal entities who have entered into the agreement.

(d) CHARGES.--The Secretary may assess such charges from non-Federal entities under an agreement entered into pursuant to subsection (c) as the Secretary determines may be necessary or appropriate to implement the purpose of this section.

(e) PERIOD OF AGREEMENT.--The Secretary shall not enter into an agreement pursuant to subsection (c) for a period of time exceeding 25 years.

(f) TERMINATION PROVISIONS.--(1) Under an agreement entered into pursuant to subsection (c), the Secretary may include a termination provision that requires the Department of Energy to pay for the unamortized balance of any special facilities acquired or constructed by the non-Federal entities who have entered into the agreement if--

(A) the RRC is shut down for lack of Federal appropriations; and

(B) the acquisition or construction of the special facilities constitutes a significant portion of the investment by the non-Federal entities under the agreement.

(2) A termination provision described in paragraph (1) may authorize the use, for the purpose of paying such unamortized balance and any other costs resulting from termination, of any Federal funds available for operating expenses pursuant to subsection (j)(2).

(3) For purposes of this subsection, the term ``special facilities'' means any depreciable buildings, structures, utilities, machinery, equipment, materials, or services not made available to non-Federal entities by the Department of Energy.

(g) OTHER AGREEMENT PROVISIONS.--Under an agreement entered into pursuant to subsection (c), the Secretary may--

(1) make available to non-Federal entities facilities, equipment, utility services, fire protection, and other similar services;

(2) lease real or personal property to non-Federal entities to carry out the purpose of this section;

(3) include an appropriate indemnification pursuant to section 170 d. of the Atomic Energy Act of 1954 (42

U.S.C. 2210); and

(4) include such other terms and conditions as the Secretary determines will implement the purpose of this section.

(h) COMPETITIVE PROCEDURES.--In entering into a contract with a non-Federal entity pursuant to subsection (c), the Secretary may use procedures other than competitive procedures as described in section 303 of the Federal Property and Administrative Services Act of 1949 (41 U.S.C. 253).

(i) PROVISIONS RELATING TO DEPARTMENT OF ENERGY CONTRACTOR.--A contractor under contract with the Department of Energy to operate the RRC shall--

(1) maintain and operate the Fast Flux Text Facility under contract with and for the account of the Department of Energy pursuant to section 110 of the Atomic Energy Act of 1954 (42 U.S.C. 2140);

(2) ensure that all experiments meet applicable safety requirements and acceptable criteria; and

(3) provide necessary support services to the non-Federal entities that have entered into agreements pursuant to subsection (c).

(j) RRC FUND.--(1) There is established in the Treasury of the United States a separate fund to be known as the ``RRC Fund''. The RRC Fund shall consist of all amounts received by the Secretary from charges assessed under subsection (d).

(2) Subject to appropriations, the Secretary may make expenditures from the RRC Fund each fiscal year to offset the cost of operating the RRC in such fiscal year. Amounts in the RRC Fund not needed for operations shall be invested in United States securities, the proceeds of which shall accrue to the RRC Fund.

SEC. 11. COST SHARING GUIDELINES.

The Secretary shall conduct a study of the appropriateness of cost sharing requirements for fossil research and development projects of the Department of Energy, taking into account the type of project and costs required for completion. Within 6 months after the date of enactment of this Act, the Secretary shall submit to the Congress a report containing the results of such study, along with proposed guidelines for cost sharing with respect to such projects, including provisions regarding the use of data, rights of parties, and ownership of the research results or technologies developed.

SEC. 12. ANNUAL BUDGET SUBMISSION.

The Secretary shall annually submit to Congress, along with the President's budget request, a 3-year budget estimate for the civilian research and development programs of the Department of Energy, including funding estimates for each major account and new initiative.

SEC. 13. AUTHORIZATION RESTRICTION.

Notwithstanding any other provision of this Act--

(1) no amount appropriated pursuant to this Act may be used for any program for which funding was requested in an annual budget request of the President but for which the Congress declined to authorize funding; and

(2) no amount appropriated pursuant to this Act may be used for any program in excess of the amount authorized for that program under this Act.

The **Chairman**. Any further discussion?

Mr. Walker.

Mr. **Walker**. Mr. Chairman, I simply would echo that it is an excellent amendment, and we are pleased to support it.

Mrs. **Lloyd**. Mr. Chairman, I would like to commend you for your amendment, and I certainly am very supportive of your amendment.

The **Chairman**. Any further discussion?

Mr. **Morrison**. Mr. Chairman, just to agree that you have put together a package that I think brings us together.

The **Chairman**. Thank you very much, Mr. Morrison.

If there are no further comments praising the Chairman's initiative——

[Laughter.]

The **Chairman**. Are there any amendments to the substitute?

Mr. **Traficant**. Mr. Chairman, for clarification, would my amendments be in order to the substitute?

The **Chairman**. Yes.

Mr. **Traficant**. I would ask consent, then, to clarify the issue that they be offered now and that the parliamentary issues be clarified later, and I offer three amendments en bloc that were previously passed on the preceding bill and asked that they be considered at this time.

[The amendments proposed en bloc by Mr. Traficant follow:]

TRAFIC064

AMENDMENT OFFERED BY MR. TRAFICANT
TO THE AMENDMENT IN THE NATURE OF A SUBSTITUTE

Page 25, after line 9, insert the following new section:

SEC. 14. BUY AMERICA PROVISIONS.

(a) RESTRICTIONS ON CONTRACT AWARDS.--No contract or subcontract made with funds authorized under this Act or any amendment made by this Act may be awarded for the procurement of an article, material, or supply produced or manufactured in a foreign country whose government unfairly maintains in government procurement a significant and persistent pattern or practice of discrimination against United States products or services which results in identifiable harm to United States businesses, as identified by the President pursuant to subsection (g)(1)(A) of section 305 of the Trade Agreements Act of 1979 (19 U.S.C. 2515(g)(1)(A)). Any such determination shall be made in accordance with such section 305.

(b) PROHIBITION AGAINST FRAUDULENT USE OF ``MADE IN AMERICA'' LABELS.--If it has been finally determined by a court or Federal agency that any person intentionally affixed a label bearing a ``Made in America'' inscription, or an inscription with the same meaning, to any product sold in or shipped to the United States that is not made in the United States, that person shall be ineligible to receive any contract or subcontract from the Department of Energy, pursuant to the debarment, suspension, and ineligibility procedures in subpart 9.4 of chapter 1 of title 48, Code of Federal Regulations.

(c) BUY AMERICAN REQUIREMENT.--(1) The Secretary is authorized to award to a domestic firm a contract for the purchase of goods that, under the use of competitive procedures, would be awarded to a foreign firm, if--

(A) the final product of the domestic firm will be completely assembled in the United States;

(B) when completely assembled, more than 50 percent of the final product of the domestic firm will be domestically produced; and

(C) the difference between the bids submitted by the foreign and domestic firms is not more than 6 percent.

(2) This subsection shall not apply to the extent to which--

(A) in the opinion of the Secretary, after taking into consideration international obligations and trade relations, such applicability would not be in the public interest;

(B) in the opinion of the Secretary, after consultation with the Secretary of Defense, compelling national security considerations require otherwise; or

(C) the President determines that such an award would be in violation of the General Agreement on Tariffs and Trade or an international agreement to which the United States is a party.

(3) This subsection shall apply only to contracts made for which--

(A) amounts are authorized by this Act, or any amendment made by this Act, to be made available; and

(B) solicitations for bids are issued after the date of enactment of this Act.

(4) The Secretary, before January 1, 1993, shall report to the Congress on contracts covered under this subsection--

(A) entered into with foreign firms pursuant to a determination made under paragraph (2) of this subsection; and

(B) awarded to domestic firms pursuant to paragraph (1) of this subsection, in fiscal years 1991 and 1992.

(5) For the purposes of this subsection--

(A) the term ``domestic firm'' means a business entity that is incorporated in the United States and that conducts business operations in the United States; and

(B) the term ``foreign firm'' means a business entity not described in subparagraph (A).

The **Chairman**. Are these the same amendments——

Mr. **Traficant**. Yes, they are, Mr. Chairman.

The **Chairman**. If the Chairman accepted them before, he has no choice but to accept them again.

Mr. **Traficant**. Thank God. [Laughter.]

The **Chairman**. Does anybody on the minority side wish to accept them?

Mr. **Morrison**. Mr. Chairman, we also have no choice on this. [Laughter.]

The **Chairman**. Oh. I was hoping they'd object to them, but since they don't, the Chair will put the amendment to the substitute first.

Those in favor of Mr. Traficant's amendment will signify by saying aye.

[Chorus of ayes.]

The **Chairman**. Opposed, no.

[No response.]

The **Chairman**. The ayes have it, and the amendment is accepted.

The Chair will now put the question on——

Mr. **Morrison**. Mr. Chairman, I would like to at least have an opportunity to mention the en bloc amendments, which I intend to withdraw.

[The amendment proposed en bloc by Mr. Morrison follows:]

Amendments Offered En Bloc by Mr. Morrison

Amendment to the substitute offered by Mr. Morrison:

On page 4, line 12, section (A) is replaced with the following:

(A) Light Water Reactor Programs, $62,500,000, for fiscal year 1992, of which $20,000,000 shall be for first-of-a-kind engineering for initiating the first standardized commercial nuclear power plant design, and $62,500,000 for fiscal year 1993, of which $20,000,000 shall be for first-of-a-kind engineering.

On page 11, lines 18 and 19, are replaced with the following:

(4) $12,646,000 shall be for Energy Storage Systems, including $8,000,000 for Hydrogen Research.

FUNDING:

The necessary across the board reduction of approximately .0057 percent is made in the authorization numbers of this bill to provide the $18,000,000 for first-of-a-kind engineering in Light Water Reactor Programs which increases from $44,500,000 to $62,500,000 for FY 1992 and the $3,400,000 for Hydrogen Research in Energy Storage Systems which increases from $9,246,000 to $12,646,000 for FY 1992.

Amendment to the substitute offered by Mr. Morrison:

Page 18, line 22, section 8 is replaced with the following:

SEC. 8. STANDARDIZED ADVANCED LIGHT WATER REACTOR DESIGNS

(a) AWARD OF CONTRACT.--The Department of Energy shall initiate a first-of-a-kind engineering design program on a competitive basis to begin in FY 1992. The DOE shall select designs for first-of-a-kind engineering with respect to standardized commercial nuclear power plant designs.

(b) SELECTION CRITERIA.--The DOE shall make the selections under subsection (a) to entities that certify to its satisfaction that they meet, but are not limited to, the following criteria:

(1) the entities, or its members, are bona fide entities engaged in the design, engineering, manufacture, and construction of nuclear reactors;

(2) the entities, or its members, fully intend to offer to construct standardized plants in the United States;

(3) the entities, or its members, have the financial resources necessary, and fully intend to pursue the design, engineering, manufacture, and construction of nuclear power plants through completion of construction and into operation;

(4) there is industry or market interest as evidenced by the ability to achieve the 50-50 cost-share basis; and,

(5) the design selected must be part of DOE's Advanced Light Water Reactor design certification and standardization program included in its 1992 budget proposal.

(c) FUNDING.--Each first-of-a-kind engineering design selected by DOE under this section shall receive at least 50 percent of its funding from non-Federal sources.

(d) STATUS REPORT.--DOE is directed to submit a status report to the Committee with the submittal of its budget request for FY 1993 describing progress in the design certification and first-of-a-kind engineering programs together with industry cost share achievements and make appropriate recommendations.

Report language offered by Mr. Morrison:

Page 16 the section beginning First-Of-A-Kind Engineering is replaced with the following:

First-Of-A-Kind Engineering

To complement the certification program, the DOE is recommending First-Of-A-Kind Engineering activities for designs in the certification program.

First-Of-A-Kind Engineering is defined as the non-recurring engineering effort to produce the detailed design information for a particular standard design, beyond the level-of-detail that is required for design certification by the Nuclear Regulatory Commission (NRC). First-Of-A-Kind engineering for advanced reactor designs will play a major role in achieving standardization for the next generation of nuclear power plants. It provides the design and economic certainty (firm cost and schedule) required by the utility industry before committing to new orders. Together with design certification and site demonstration programs, completing First-Of-A-Kind engineering will provide assurance that the next generation of reactors is available for orders by 1995, which is the goal set by the Nuclear Power Oversight Committee (NPOC), the policy coordinating body of the nuclear industry, in its "Strategic Plan For Building New Nuclear Power Plants" published in 1990. In the FY 1992 budget submission to the Congress, DOE proposes to initiate a First-Of-A-Kind program to perform more detailed engineering of plant systems, required key components, structural modules, and systems beyond the scope for certification. The goal is to achieve commercial standardization of the essentially complete plant.

Report Language offered by Mr. Morrison:

On Page 22 the section titled Light Water Reactors is replaced with the following:

The Subcommittee received testimony on the Light Water Reactor (LWR) program on March 6, 1991. At that time, the DOE stated that during fiscal year 1992, DOE and industry will continue with two cooperative cost-shared programs, to develop and certify advanced light water reactor designs. One program supports certification of two evolutionary standardized designs, while the second supports two advanced passive standardized designs. The objective is to have all four designs certified by 1995.

The Subcommittee agrees that the certification of standard reactor designs is a positive step toward revitalizing the nuclear power option and recommends continuation of support and completion of the System 80+, Advanced Boiling Water Reactor (ABWR), Advanced Pressurized Passive-600 Megawatt-electric (AP-600), and Simplified Boiling Water Reactor (SBWR) programs. The Subcommittee also believes that balance of plant considerations are an important part of this certification effort.

Furthermore, the Subcommittee supports a new program for first-of-a-kind engineering to carry out standardized, non-recurring engineering for selected plant designs. The Subcommittee recognizes that it cannot support all of the first-of-a-kind engineering for all of the reactor designs in the current or foreseeable budget climate. The Subcommittee believes the most important role that this program can play is to provide an incentive for initiating cost-shared programs with the private sector for first-of-a-kind engineering designs.

Therefore, the Subcommittee authorizes $20,000,000 in FY 1992 and $20,000,000 in FY 1993 for the first-of-a-kind program.

The CHAIRMAN. The Chair is happy to recognize the gentleman from Washington.

Mr. MORRISON. Mr. Chairman, this is in the spirit of this entire markup that I will withdraw the en bloc amendments that I had proposed to your substitute. I just would ask, though, for a couple of moments to report to the committee that some very spirited efforts have gone into attempting to close the loop even a little tighter. Mr. Walker has some interests, and you, Mr. Chairman, as you have mentioned in your opening comments. I certainly have on behalf of advancing the concept called first-of-a-kind engineering, which is one of the top priorities for the Department of Energy.

We're so close to having the right verbiage here, and I just wanted to get assurance from you, Mr. Chairman, that this subject area of these amendments is what you mentioned, or at least part of what you mentioned, in your opening comments that you would be offering amendments that would cover these areas.

The CHAIRMAN. Would the gentleman yield?

Mr. MORRISON. I will yield to the Chairman.

The CHAIRMAN. I am familiar with the gentleman's amendments and the efforts that he's making to reconcile these amendments so that all points of view are properly represented. I think that the only problems that we have now are making sure that the final language has been reviewed by sufficient individuals so that we don't have any misunderstandings, and I reiterate my comment to work with the gentleman and to offer this en bloc amendment as a floor package as soon as we make sure that it's adequately reviewed.

Mr. MORRISON. I thank the Chairman, and I yield to my ranking member.

Mr. WALKER. That's certainly my understanding, and as the gentleman may know, Chairman Brown and I share a very avid interest in advancing hydrogen research. That is one of the things that was going to be corrected in the gentleman's en bloc amendment. It is certainly one of the things that we want to work on for the future, and I think we are going to be able to work out some of these areas. So I thank the gentleman for his——

Mr. MORRISON. With the assurance of my two leaders and my discussions with my chairman, Mrs. Lloyd, I would ask to withdraw the amendment.

The CHAIRMAN. Without objection, the gentleman's request is granted.

The Chair recognizes Mrs. Lloyd.

Mrs. LLOYD. Mr. Chairman, I, too, want to address the concerns of Mr. Morrison that I also share.

I think we all had problems as we looked at the programs under our jurisdiction, and there were a lot of changes we would have liked to have made. Unfortunately, we were restricted by budgetary constraints, and I do hope we can make it an even better, more balanced bill.

At this time, I'd like to offer an amendment that Mr. Valentine had planned to offer. I don't have any objection to it.

The CHAIRMAN. Would the staff distribute the amendment by Mr. Valentine?

Mrs. **Lloyd**. Mr. Chairman, this provides $6 million for technical and financial assistance for Inventions and Innovations. It will be transferred to the National Institute of Standards and Technology to carry out its functions under section 14 of the Federal Non-Nuclear Energy Research and Development Act of 1974.

I think it's a good amendment. I don't have any objection to this amendment.

[The amendment proposed by Mr. Valentine follows:]

TB090

H.R. 2399

AMENDMENT OFFERED BY Mr. Valentine

TO THE AMENDMENT IN THE NATURE OF A SUBSTITUTE

Page 11, line 22, strike ``$326,900,000'' and insert in lieu thereof ``~~$333,400,000~~''. "$332,900,000."

Page 14, line 12, strike ``and''.

Page 14, line 13, strike the period and insert in lieu thereof ``; and''.

Page 14, after line 13, insert the following new paragraph:

(5) ~~$6,500,000~~ $6,000,000 shall be for technical and financial assistance for the Inventions and Innovations, ~~Program,~~ of which $2,200,000 shall be transferred to the National Institute of Standards and Technology to carry out its functions under section 14 of the Federal Nonnuclear Energy Research and Development Act of 1974.

The **Chairman**. Any further discussion of this amendment by Mr. Valentine?

[No response.]

The **Chairman**. The Chair has been assured by the staff that this is a proper amendment and does not disturb the delicate balance that we've reached in the substitute amendment and is willing to accept it.

Mrs. **Lloyd**. Mr. Chairman, I move the adoption of the amendment.

The **Chairman**. The gentlelady moves the adoption of the amendment. Is there any further discussion on the part of any member?

[No response.]

The **Chairman**. If not, the Chair will put the question.

All those in favor, signify by saying aye.

[Chorus of ayes.]

The **Chairman**. Opposed, no.

[No response.]

The **Chairman**. The ayes have it, and the amendment is agreed to.

Are there further amendments to the Chairman's substitute?

[No response.]

The **Chairman**. If not, the Chair will put the question.

All those in favor, signify by saying aye.

[Chorus of ayes.]

The **Chairman**. Opposed, no.

[No response.]

The **Chairman**. The ayes have it, and the Chairman's substitute is adopted.

We should put the question, I guess, on the bill, as amended. Is that right?

At this time, we should consider any proposed committee views or report language.

Mr. Mineta.

Mr. **Mineta**. Mr. Chairman, I have an amendment as it relates to the report of the committee, and I first want to congratulate you for the markup session, as well as Mr. Walker and all the subcommittee chairs and ranking Republicans for their hard work on the bills that are coming before us today.

The amendment I am offering today will require the Secretary of Commerce to report on the degree to which there is interaction between private industry and the national laboratories in selecting research goals and objectives. A major obstacle facing high-technology industries in the United States today, Mr. Chairman, is the staggering cost and high risks of commercializing new technologies. Approximately $20 billion worth of research and development is conducted by Federal laboratories annually. Half of the R&D funded in this country is conducted by the Federal Government. Federal laboratories employ a total of 185,000 scientists, and this represents one-sixth of the Nation's scientists.

The challenge for both our Government and our industry is to work together to create the conditions that will make the United States competitive in the world economy. A role that the Federal Government must play in this relationship is one that will create an environment that fosters and supports the transfer of technology from the Federal laboratory to the commercial sector.

So, Mr. Chairman, my amendment will call upon the Secretary of Energy to examine the ways the resources within the national labs are used to advance technological innovations so that we can examine how to improve the competitiveness of the private sector.

[The amendment proposed by Mr. Mineta follows:]

H.R. 2377

AMENDMENT TO COMMITTEE REPORT LANGUAGE
OFFERED BY MR. MINETA

Page ___.

STRATEGIC REPORT.--The Committee directs the Secretary, within 6 months after the enactment of this Act, to submit to Congress a report outlining the extent to which the national laboratories are being utilized to enhance our nation's industrial competitiveness in high technology industries. The Report should contain a detailed analysis of any research efforts, current or planned, within the National Laboratories to respond to the long-term needs of generic, pre-competitive technologies including, but not limited to, biotechnology, semiconductors, supercomputers, and high definition systems. The Report should detail the degree of cooperation between the Department and critical high technology industries in formulating research goals and the extent to which the competitiveness of these high technology industries factor into research decisions.

Mr. WALKER. Will the gentleman yield?

Mr. MINETA. I'd be more than pleased to yield.

Mr. WALKER. I just want to clarify one thing. The gentleman, in his early remarks, referred to the Secretary of Commerce. It is our understanding that, because of the nature of the bill, it would be the Secretary of Energy.

Mr. MINETA. It would be the Secretary of Energy. I'm sorry.

Mr. WALKER. I thank the gentleman.

Mr. RITTER. Will the gentleman yield?

The CHAIRMAN. The gentleman from Pennsylvania?

Mr. MINETA. I would be pleased to yield.

Mr. RITTER. Well, first of all, I want to commend the gentleman on his movement toward bringing these critical technologies to the forefront and bringing focus to them and his interest in seeing to it that what we do is also coordinated with what the private sector is doing so that the right hand does know what the left hand is doing.

I also want to submit that if we could simply put into the sentence that talks about "including but not limited to biotechnology, semiconductors, supercomputers, and high- definition systems," if we could enter in "superconductivity" as well, I think it stands appropriately with those other fields.

Mr. MINETA. I have no objection to the addition of superconductors.

Mr. RITTER. I thank the gentleman.

The CHAIRMAN. Without objection, that change will be made.

Is there any further discussion of Mr. Mineta's proposed addition to the report language?

[No response.]

The CHAIRMAN. If not, without objection, that will be accepted.

Are there any further proposals for changes in report language?

[No response.]

The CHAIRMAN. If not, it will be in order to have a motion to report the bill.

Mr. WALKER. Mr. Chairman, I move that the committee report the bill H.R. 2399, as amended, and instruct the staff to prepare the legislative report and to make technical and conforming amendments, and that the Chairman take all necessary steps to bring the bill before the House for consideration.

The CHAIRMAN. You've heard the motion. Is there any debate on the motion?

[No response.]

The CHAIRMAN. If not, the Chair will put the question.

All those in favor, signify by saying aye.

[Chorus of ayes.]

The CHAIRMAN. Opposed, no.

[No response.]

The CHAIRMAN. The ayes have it, and the bill is reported.

[Whereupon, at 12:27 p.m., the committee adjourned, to reconvene at the call of the chair.]

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45-015 (428)